MERLIN-DASH

FOR WINDOWS

DESIGN, ANALYSIS AND RATING OF STRAIGHT GIRDER BRIDGE SYSTEMS

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WIN-DASH[1] User Manual

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1.0 INTRODUCTION

1.1 Abstract

MERLIN-DASH (**D**esign, **A**nalysis and Rating of **S**traig**H**t Girder Bridge Systems) was developed for use by bridge design engineers who function in a software production environment. In order to provide a program which would be applicable nationally, the BEST Center developed ***MERLIN-DASH*** to offer the widest range of features and options possible.

MERLIN-DASH incorporates a standardized sequence of steps starting with analysis and proceeding, at the user's option, to perform a code check, design and/or rating which allows for the following:

1. **Analysis Only :** For the analysis of dead and/or live load effects;

2. **Analysis/Code Check:** For analysis and then code checking;

3. **Analysis/Rating :** For rating or posting of existing structures;

4. **Design :** For design with weight or cost optimization;

5. **Design/Code Check :** Void;

6. **Design/Code Check/Recycle :** First design, then recycle to re-analyze the designed section, then perform a code check;

7. **DL Stage Analysis :** Dead Load pouring sequence stage analysis;

8. **DL + LL Stage Analysis :** Dead Load pouring sequence stage and Live Load analysis.

The generality of the program also extends into the structural model incorporated within ***MERLIN-DASH***. The structural analysis is performed using a series of modular subroutines which are based on the stiffness method. Utilizing this methodology allows the use of various specialized members such as straight and parabolic haunches, hinges, and flanged transitions. The loading capabilities of ***MERLIN-DASH*** include joint, concentrated and segmented uniform member loads. An extensive mesh generation capability allows for the incorporation of fully automated AASHTO Dead Load (DL) and Live Load (LL) sequences. A highly general and wide range of live load capabilities are also incorporated into ***MERLIN-DASH***.

1. Standard **AASHTO** truck and lane loadings
2. Non-standard **AASHTO** loadings (e.g., HS 25, HS 26, . . ., etc.)
3. The interstate (or tandem) vehicle
4. Various standard state truck configurations
5. Generalized (user-specified) two- and three-axle trucks

6. A generalized, up to 20-axle, user-defined truck where direction of travel may be specified
7. Generalized predefined truck files.

A more detailed description of the capabilities of ***MERLIN-DASH*** is given in Chapter 2.

1.2 History of *MERLIN-DASH*

For nearly twenty years the Maryland State Highway Administration (MD SHA) Bureau of Bridge Development has sponsored research at the Department of Civil Engineering, University of Maryland College Park, to develop bridge design software. One of the first systems to be undertaken was the ***MERLIN-DASH*** program.

Since the completion of the basic system in 1978, ***MERLIN-DASH*** has become widely used and has undergone numerous revisions and upgrades. The mainframe version was in use within various state and municipal design agencies. ***MERLIN-DASH*** was selected by the ***National Highway Research Program Committee 12-18*** as the **most general program for universal application on a national basis**. It is also used by Federal Highway Administration (FHWA) demonstration project DP-81 *" Load Factor Design by Computers "* as a result of which delivered to over thirty states.

1.3 Support for *MERLIN-DASH*

Both first and second level support are available to users on the operation, assumptions, and problems related to the ***MERLIN-DASH*** program. First level support, which is the first contact for all user initiated queries, is generally provided by the authorized vendor from whom the program was purchased.

The ***BEST*** Center staff will provide second level, in-depth, technical support as a backup to the vendor for unresolved issues relating to first level support. In addition, the ***BEST*** Center will make:

Bug Fixes: The ***BEST*** Center will make every effort to identify and rectify all verified bugs within ***MERLIN-DASH***. The user should report all suspected bugs, program abnormalities, and suggested improvements to the authorized vendor from whom the program was purchased.

Code Updates: The ***BEST*** Center will perform updates consistent with the changes specified within revisions of the AASHTO Standard and LRFD Specifications for Highway Bridges or appropriate addenda. These updates of ***MERLIN-DASH*** will be performed as required to provide the user access to the most current code provisions.

Program Upgrades: Periodically, the ***MERLIN-DASH*** system will be modified to accommodate enhancements. Such upgrades may include features which already exist within the network or single user version or which are newly developed for the microprocessor.

2.0 OVERVIEW

MERLIN-DASH is a window application program written in **FORTRAN 90, VB and C++** and .NET Framework 4 languages which consists of more than 100,000 statements. The block flow chart of the program is given in Figure 2.1. In this chapter, the capabilities and methodology will be discussed.

2.1 Program Capabilities

A full range of features has been incorporated into ***MERLIN-DASH*** which provide for the most general usage. These are categorized into those features which either are available currently or are under active development. The features are described as follows:

SYSTEM FEATURES

A full range of general, user-friendly, features are available with ***MERLIN-DASH***, including: a Windows-based pull-down menu system, indexed output tables, the ability to perform a complete and rigorous analysis and code check, design and rating capabilities, and a wide range of graphics plots which serve to greatly enhance the users ability to quickly and accurately interpret the numeric output.

SPECIFICATIONS

Various code specification methods are available in ***MERLIN-DASH*** including the AASHTO WSD, LFD and LRFD alternates for both design and rating. The analysis and code check are fully detailed and based on the AASHTO specifications (see item 2.0 in Table 2.1).

UNIT SYSTEMS

The user has the option of choosing either *U.S. Customary* or *S.I.* input and output. ***MERLIN-DASH*** will perform all design, code check, analysis, rating, and graphics plots using the selected unit system.

STRUCTURAL MODEL

A number of features are available within ***MERLIN-DASH*** which allow the analysis of diverse bridge configurations (see item 3.0 in Table 2.1). A summary of the assumptions contained within the program are given in Table 2.2.

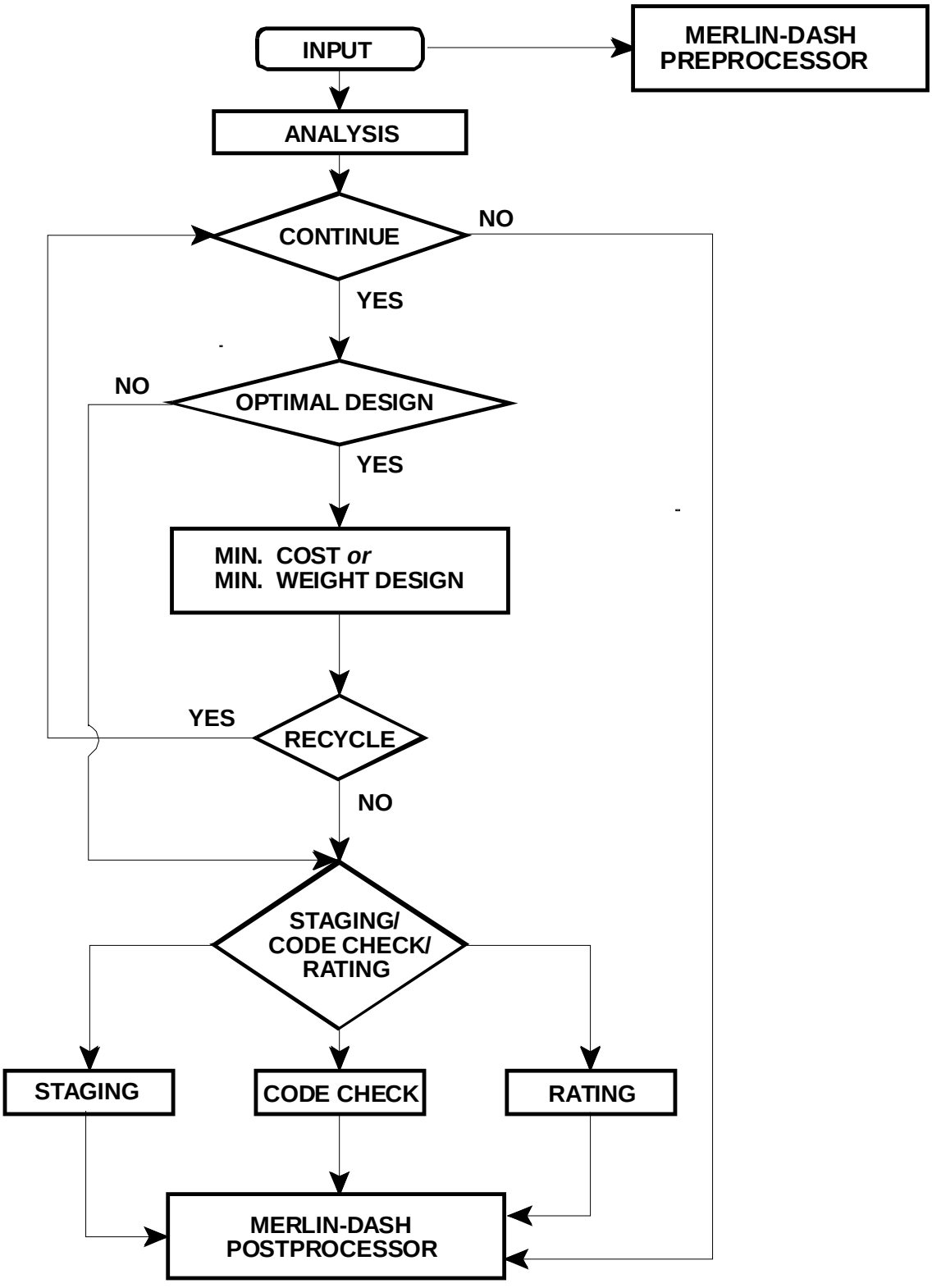


Figure 2.1 : The Flow Chart of *MERLIN-DASH*

TABLE 2.1 : Summary of Features and Options

1.0 SYSTEM FEATURES

1.1 Menu driven input
1.2 Menu driven input data editing
1.3 Discrete help screen for every input screen
1.4 User selected output levels
1.5 Graphics for DL and LL deformation
1.6 Moment and shear diagram graphic output
1.7 Indexed output tables in 8½ H 11" format
1.8 Built-in diagnostic level output
1.9 Output at designated intervals
1.10 Output automatic at changes-in-section
1.11 Minimum input requirements
1.12 Capability of performing a full and detailed analysis
1.13 Design recycling

2.0 SPECIFICATIONS

2.1 Latest AASHTO WSD, LFD and LRFD specifications
2.2 Bridge rating for WSR, LFR and LRFR
2.3 Fully automated analysis, code check for WSD, LFD, and LRFD
2.4 A minimum cost/weight design for WSD, LFD or LRFD

3.0 STRUCTURAL MODEL

3.1 Up to 10 simple or continuous spans
3.2 Hinges at any location during different stages
3.3 Prismatic or stepped prismatic sections
3.4 Linear haunches
3.5 Various parabolic haunches
3.6 Standard rolled section table lookup
3.7 Standard sections with cover plates
3.8 Plate girder sections
3.9 Composite or Non-composite construction
3.10 Composite or Non-composite in negative moment regions
3.11 Hybrid
3.12 Precast prestressed concrete beam

4.0 LIVE LOADING

4.1 All AASHTO trucks and lane loadings
4.2 Tandem or interstate loading
4.3 A menu of trucks specified by the user
4.4 Generalized trucks
4.5 Extended AASHTO truck and lane loadings
4.6 User-specified trucks up to 20 axles
4.7 Impact automatically determined with user over-ride capability
4.8 Sidewalk LL
4.9 Distribution factor automatically determined with user over-ride capability
4.10 All LRFD live load provisions including vehicles, distribution and impact factors

5.0 DEAD LOADING

5.1 All DL conditions given automatically
5.2 Special DL conditions
5.3 DL staging analysis

6.0 ANALYSIS

6.1 Full and detailed analysis
6.2 Analysis includes: Section properties, moments, shears, reactions, deflections, camber, stresses and stress ranges for DL and LL minima/maxima
6.3 Arbitrary boundary conditions

7.0 CODE CHECK

7.1 A full and detailed formal code check for the AASHTO WSD, LFD and LRFD
7.2 The code check includes: The AASHTO specification reference, the equation number and applicable coefficients given in the output
7.3 All provisions of the AASHTO specifications are utilized
7.4 Moment-Shear interaction

8.0 RATING

8.1 The program allows the user to calculate inventory, operating and safe load capacity rating

9.0 DESIGN

9.1 Design with minimum weight or minimum cost
9.2 Design with stiffeners or without stiffeners
9.3 Fix web and/or flange plate sizes
9.4 Specify maximum and minimum plate sizes
9.5 Specify types of material and their costs
9.6 Specify field splice locations
9.7 Rolled beam design

LIVE LOAD

MERLIN-DASH incorporates a wide range of highly general Live Load capabilities (see Item 4.0 in Table 2.1).

DEAD LOAD

All Dead Load conditions, including Dead Load staging analysis, are given automatically for both composite and non-composite construction in accordance with AASHTO (see item 5.0 in Table 2.1).

ANALYSIS

A comprehensive range of analysis capabilities is available with ***MERLIN-DASH***. These capabilities are demonstrated in the detailed, voluminous, and user selectable outputs which are generated for section properties, moments, shears, deflections, cambers, reactions, stresses for dead loadings, maxima/minima for moments, shears, deflections, and reactions and stresses for live loadings (see Tables 7.1 and 7.2 in Section 7.0).

CODE CHECK

MERLIN-DASH performs a rigorous and detailed code check for the AASHTO WSD, LFD, and LRFD alternate design methods. The code check includes a comparison of all actual stresses or stress resultants (e.g., moments, shears, etc.) and stress ranges to the allowable values generated automatically by the program. Supplementing all code check results, in the program output, are the applicable code equation numbers, the code provisions, and the constants which are used to calculate the allowable values. These results are given for all fatigue and non-fatigue details. Flags highlight all overstressed conditions.

GRAPHICS

The ***MERLIN-DASH*** Windows version includes various graphics which support the tabular output. These include moment and shear diagrams for all DL conditions, moment and shear envelopes for LL conditions, and deflection and camber curves for composite and non-composite construction. Also included are stress ranges, stresses, and allowable stresses for top and bottom flanges.

RATING

MERLIN-DASH provides the inventory, operating, and safe load capacity ratings WSD, LFD, and LRFD.

DETAILED DESIGN

MERLIN-DASH can perform detailed designs utilizing either the AASHTO WSD, LFD, or LRFD methodologies. Among the various features available to the users are design recycling, placement of lateral bracing, capacity increases for unbraced sections, the shear/moment interactions, stiffener requirements, and code checks.

OPTIMUM DESIGN

Incorporated within ***MERLIN-DASH*** is the capability to generate optimal designs based upon minimum cost. Included within this procedure are determinations of the sections, splices, welds, stiffeners, etc.

2.2 Methodology

This section briefly describes the methodology used in ***MERLIN-DASH***.

ANALYSIS

The analysis techniques used in ***MERLIN-DASH*** are based upon the direct stiffness method which possesses many advantages over other popular approximate methods such as moment distribution or slope deflection. An automatic mesh generation is performed within ***MERLIN-DASH*** which automatically sequences all nodal points and section properties for each AASHTO dead load and live load condition. Here, mesh changes for various loading and construction conditions are generated automatically which results in the following advantages:

1. The analysis is accomplished using only those changes-in-section which actually exist on the structure with no numerical approximation required.
2. The analysis can easily accommodate various specialized elements and boundary conditions.
3. The analysis offers much greater efficiency than other popular methods.

The stiffness methodology incorporates both joint and member loads. A summary regarding the assumptions inherent in ***MERLIN-DASH*** is given in Table 2.2. A definition of the program limits is given in Table 2.3. The assumptions regarding each of these construction types as well as for LL moments of inertia are given in Table 2.4. Loading assumptions for all load types are given for composite and non-composite construction in Table 2.4.

Table 2.2 : Assumptions

NO.	ITEM
1	Deflections are small
2	Material is elastic
3	Beam length is much greater than lateral dimensions
4	Torsional effects are neglected
5	Shear deformations are neglected
6	Two kinematic degrees-of-freedom are assumed at each joint (vertical deflection and rotation)
7	Concentrated member loads
8	Uniform member loads
9	Members assumed prismatic between joints
10	Non-prismatic (with haunches) members modeled with automatic joint generation
11	Transformed sections are used for composite sections
12	Sections symmetric about Y-Y axis

Table 2.3 : Program Limits

NO	DESCRIPTION	MAX. NO.
1	Joints	150
2	Sections	70
3	Members	149
4	Hinges	10
5	Spans	10
6	Supports	11
7	Output intervals per span	20
8	Lateral bracing sets	30
9	Longitudinal stiffener sets	30
10	Transverse stiffener sets	30
11	Live axle loads	20
12	Impact factors per span	1
13	Arbitrary uniform dead load	20
14	Arbitrary concentrated dead load	20
15	HS vehicles HS-	99
16	Field sections	20

DESIGN

MERLIN-DASH allows steel plate girder and rolled beam design by using WSD, LFD or LRFD methods. The construction can be either composite or non-composite. By default, the program designs a prismatic girder/beam with constant web depth but varied flange and web thickness along the girder/beam. Since version 6.1 for DOS, the program allows the design of girders with haunch.

In a typical optimization problem one must define the Variables, the Design Constraints, and the Objective Function. The design variables for a typical plate girder section are the top flange width and thickness, web plate depth and thickness, the bottom flange width and thickness, and the transverse stiffener spacing. The design constraints are the limitations imposed on the design variables which can be classified as Side Constraints or Behavioral Constraints. The Side Constraints are imposed either by the program's built-in limitations based on the engineering judgment, or the user's input based on the design case (i.e., max. web depth). The Behavioral Constraints are those constraints associated with the structural behavior and the AASHTO code requirements. The Objective Function can be either Minimum Weight Optimization or Minimum Cost Optimization. The Minimum Weight Optimization is an optimization of the cross-sectional area of the design members. On the other hand, the Minimum Cost Optimization includes the cost model for bridge elements to the objective function for the optimization problem.

TABLE 2.4 : Loading Assumptions

LOAD TYPE	MODULAR RATIO		ASSUMPTIONS
	COMPOSITE	NON-COMPOSITE	
Steel DL	Infinity	Infinity	DL (steel) = (Uniform Member Loads) x (Detail Factor) where Uniform Member Loads = Steel Only Detail Factor = Connections, etc. Unit Weight of Steel 490 lb. per cu. ft.
Slab DL	Infinity	Infinity	Slab DL = Uniform member load taken as input
SDL	N1	Infinity	SDL = Wearing surface, parapets, etc. taken as uniform member loads or as input
Arbitrary Loads	As Input	Infinity	Taken as uniform or concentrated loads along member as input
Live Load	N2	Infinity	AASHTO truck and lane loads taken to give maximums
Staging	Varied	---	Each pour is considered superimposed dead load, and partial composite is considered for each stage.

DEAD LOADINGS

For steel beam bridges which act compositely with reinforced concrete decks, the analysis proceeds in stages. Non-composite bridges utilize steel only for all DL conditions (see Table 2.4).

LIVE LOAD MAXIMA

Live load falls into two major categories - maximum live load moments and maximum live load shears. Maximum live load deflections for each span are also obtained during the process of computing the maximum live load moment. In addition, reactions at each support due to live load are computed and listed in the program output. The maximum values of each of the specified highway loadings (AASHTO lane and truck, tandem, special vehicle, truck-train loading) are retained as needed. Only maxima are given for each interval and are utilized in constructing envelopes. If impact and distribution factors are not specified by the user, they will be automatically calculated in accordance with AASHTO. All live loading computations are influenced by these two factors except for the sidewalk live load, which is directly applied to the outside girders.

AASHTO LOADINGS

For a truck loading, each axle is moved over the current interval point to produce maximum positive moment. The same process is applied to lane loading, but only the minimum point on the moment influence line of the entire structure is considered as the point where the truck will be moved to obtain the maximum negative moment. Two directions of travel are taken into consideration if not otherwise specified. (A unidirectional direction can be specified if it is desired). Tandem loading is treated in an identical manner.

For maximum positive shear, the distributed loads are applied from the current point to the right end of the span and every other span in that direction, and the previous span plus every other span in that direction. The concentrated load of the lane loading will be just to the right or left of the point under consideration to produce the maximum positive or negative shear. In calculating

end shears and reactions, no distribution factor for the wheel loads needs to be applied according to AASHTO 2.23.1.1.

LRFD Application of Design Vehicular Live Loads:

1. The fatigue load shall be one design truck or axles specified in LRFD Art. 3.6.1.2.2, but with a constant spacing of 30.0 ft. between the 32.0-kip axles. The dynamic load allowance (IM) is 15%.

2. Maximum live load is the larger of the following

- The effect of the design tandem (IM=33%) with combined with the effect of the design lane load, or
- The effect of one design truck with the variable axle spacing specified in LRFD Art. 3.6.1.2.2 (IM=33%), combined with the effect pf the design lane load, and
- For both negative moment between points of contraflexure under a uniform load on all spans, and reaction at interior piers only, 90% of the effect of two design trucks (IM=33%) spaced a minimum of 50.0 ft. between the lead axle of one truck and the rear axle of the other truck, combined with 90% of the effect of the design lane load. The distance between the 32.0 -kip axles of each truck shall be taken as 14.0 ft.

SPECIAL LOADINGS

Due to the increasing number of non-standard trucks currently in use, ***MERLIN-DASH'S*** capability of handling special loadings allows the user to compute the rating or the posted weight limits for any bridge. The special loading capabilities include:

1. Dump Truck (2D or 3D)
2. Maximum Allowable Trucks (MST76, Type 3, 3S2, 3-3)
3. General Vehicles (when the axle loads and spacing are defined by the user).
4. Special Vehicles (where the axle loads and spacings of up to 20 axles can be defined by the user).

Special vehicles must be input and run independently from the other loading cases. The identical procedure for calculating the AASHTO moments and shears is also utilized for the specified special truck loading within ***MERLIN-DASH.***

DEFINITION OF TRUCKS

MERLIN-DASH allows users to specify their own truck configurations in a predefined truck file. This file is in an ASCII format and must be defined prior to the ***MERLIN-DASH*** run. It contains the truck name, number of axles, axle weights and spacings.

Predefined truck files, for several AASHTO rating trucks, are included in your ***MERLIN-DASH*** software package. The files TRUCK26.DAT and TRUCK26M.DAT contain the truck configurations in *U.S. Customary* and *S.I.* units, respectively. ***MERLIN-DASH*** allows the simultaneous execution of the AASHTO Truck (A) (see attachment 6 of this user's manual for the format of the truck files), Dump Truck (D), Maximum Allowable Truck (M), and General Vehicle (G), or the single execution of the Special Vehicle (C). For the simultaneous execution of trucks A, D, M, and G., the program will pick up the maximum values of the results induced by these trucks. The single execution of the Truck C will give the results induced by this single loading.

The AASHTO Truck should be defined according to the AASHTO Manual (or proportioning up to HS-99) while the Special Vehicle is defined in Screen numbers 12 and 13 of ***MERLIN-DASH*** Input Utility.

1. Dump Truck (D). The only limitations for defining Dump Trucks are:

Dump Truck Loading Designation	- 2 Characters
Number of Axles	- 3 Axles

If the number of axles exceeds three, or the loading designation is not specified in the predefined truck file, the program will give an error message and be terminated.

2. Maximum Allowable Truck (M). The limitations on user input are:

Maximum Allowable Truck Loading Designation	- 6 Characters
Number of axles	- 6 Axles

If the number of axles exceeds six, or the loading designation is not specified in the predefined truck file, the program will give an error message and be terminated.

3. General Truck (G). The limitations on user input are:

General Loading Designation	- 4 Characters
Number of Axles	- 20 Axles

If the number of axles exceeds twenty or the loading designation is not specified in the predefined truck file, the program will give an error message and be terminated.

In the LRFD calculation for live load:

1. For Strength I, Service I, and Fatigue Limit States, only HL-93 (truck + lane & interstate + lane) is considered. Default or user-specified distribution factors (for either moment or shear) are employed.

2. For Service II: Maximum of HL-93 and Permit is considered. Default or user-specified

distribution factors (for either moment or shear) are employed.

3. For Strength II: Maximum of HL-93 and combination of (one lane Permit and adjacent lanes HL-93) is considered where G defined in Eq. (4.6.2.2.4-1) is applied with default or user-specified distribution factors (for either moment or shear) as their respective "gm" (multiple lane live load distribution factor).

These considerations apply to all actions, (M, V, D and R).

MOMENT/SHEAR INTERACTION

In calculating the live load moment for each loading case, there will be two envelopes formed - one for maximum positive moment and one for maximum negative moment. The shear corresponding to each moment case is also computed and stored so that the interaction equation required for the design of transverse stiffeners can be accurately calculated. The maximum deflection of each span is computed and stored to compare with the allowable deflection given in AASHTO 10.6. Only two moment envelopes, one positive and one negative, are generated for special vehicles.

Two shear envelopes and their corresponding moments are recorded for each loading case. These separate moment and shear diagrams lead to the calculation of consistent fatigue stress ranges for each number of live load cycles.

RATING

The WSD and LFD rating methods contained in AASHTO *Manual for Condition Evaluation of Bridges* and the LRFD method contained in AASHTO *The Manual for Bridge Evaluation* are employed within ***MERLIN-DASH***.

STAGING

After a bridge design is completed using MERLIN-DASH, the same data file can be used for staging analysis. The pouring days of the consecutive pouring, after the first pour, can be input. The modulus of elasticity and the creep effects will be determined by the program. The intermediate moments, stresses and deflections will be included in the output.

3.0 USING MERLIN-DASH

MERLIN-DASH is currently available for use on micro-computers using the Microsoft Windows environment. This manual describes the Windows version of ***MERLIN-DASH***, hereafter referred to as ***WIN-DASH***. This version utilizes a Windows based pull-down menu structure to access ***WIN-DASH's*** input, execution, graphing, and printing utilities.

3.1 Before You Begin

WIN-DASH has been designed to run on micro-computers that use the Microsoft Windows operating system. While this manual provides step-by-step instruction in the use of ***WIN-DASH***, it cannot address the specific operation of every personal computer (PC). Before you begin, please ask yourself the following questions:

1. Are you familiar with the PC or micro-computer you are using?
2. Are you familiar with Microsoft Windows?
3. Do you have an understanding of the concepts and use of terms such as menus, help screens, the cursor, the mouse, files, etc.?
4. Have you read/installed the ***WIN-DASH*** software using the installation instructions you received with your system disks?
5. Have you filed your installation instructions with your other ***WIN-DASH*** reference material?

If you cannot answer "Yes" to all of these questions, please take the time to address them before continuing in this manual.

If you are prepared to continue, take a moment to look over the Table of Contents provided at the beginning of this manual. You will find that the remainder of this document illustrates the detailed use of the four basic utility functions of ***WIN-DASH:***

Section 4.0	The Input Utility	Section 6.0	The Graphic Utility
Section 5.0	The Run Utility	Section 7.0	The Print Utility

The remainder of this section describes how to enter ***WIN-DASH*** and how to access the Main Menu.

3.2 Accessing the Main Menu

The ***WIN-DASH*** MAIN MENU is the main access screen to each of the utilities provided within the ***WIN-DASH*** system. It is also the main return point when you have finished using one of the utilities.

If you have not yet done so, please refer to your installation instructions and install your ***WIN-DASH*** software.

If your PC is currently off, simply turn it on and run Microsoft Windows. After entering Windows, ***WIN-DASH*** can be run by double-clicking the ***WIN-DASH*** (or ***DASHLRFD***) icon. The ***WIN-DASH*** Introduction Screen will be displayed on your monitor for a few seconds.

This screen contains both the copyright statement and the version number of the ***WIN-DASH*** software you will be using. This version number will be important in all communications with the BEST CENTER and your ***WIN-DASH*** vendor.

Figure 3.1 : WIN-DASH Title Screen

3.3 The *WIN-DASH* Main Menu

This screen allows you to access any of the five utilities available in ***WIN-DASH*** or to exit the program. These are the Input, Run, Graphic, Print and Help utilities.

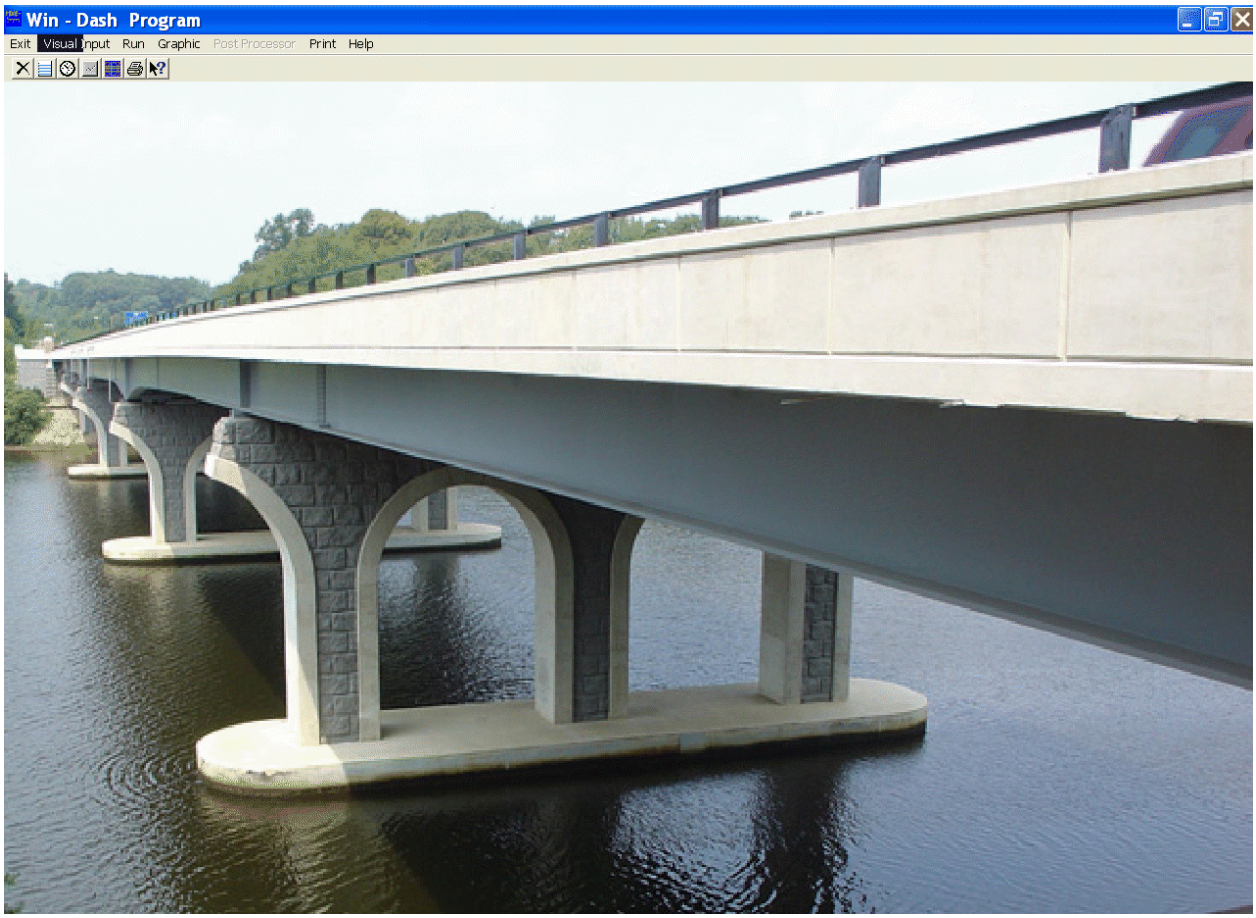


Figure 3.2 : WIN-DASH Main Menu Screen

Visual Input Utility - allows you to create new bridge data files or to edit existing files. Once you have entered the details of a structure, you can then save it for later use. For detailed instructions on using the pull-down menu system of the Visual Input Utility refer to Section 4.0.

Run Utility - allows you to execute the ***WIN-DASH*** program using the data stored in any of your input data files. For detailed instructions on using the Run Utility refer to Section 5.0.

Graphic Utility - allows you to view and print output graphic files. For instructions on using the Graphic Utility refer to Section 6.0.

Post Processor - please refer to Appendix E for details.

Print Utility - allows you to view and print output files and tables. It also provides a directory of available tables for your convenience. For instructions on using the Print Utility refer to Section 7.0.

Exit - allows you to exit ***WIN-DASH*** simply by clicking on the word 'Exit' in the ***WIN-DASH*** Main Menu or by typing Alt-x on your keyboard.

Help Utility - allows you to view help for the Help basics, how to, commands and buttons. Hit F1 key will bring up the input description of the current input screen. Help Utility may also be accessed from Input Utility(see Section 4.5).

To access any of the utilities available from the Main Menu, use your mouse to position the cursor over the desired utility, such as 'Input,' and click once. The utilities may also be accessed using the "button" below them. A new screen will appear with a menu listing the options available under that utility. By again positioning the cursor over the desired menu item and clicking the left mouse button a submenu will appear with additional options. With the cursor positioned over the desired option, click the mouse button once to choose that option. Sections 4.0 - 7.0 will provide a step-by-step explanation of each of the options available under each utility. Each of the utilities can also be accessed by pressing the appropriate underlined letter on the menu bar while holding down the ALT key. For example, the Input Utility could be accessed by typing ALT-I, the Run Utility by typing ALT-R, etc. All the sub-menu's in ***WIN-DASH*** can also be accessed by using the ALT key in this manner.

4.0 INPUT UTILITY

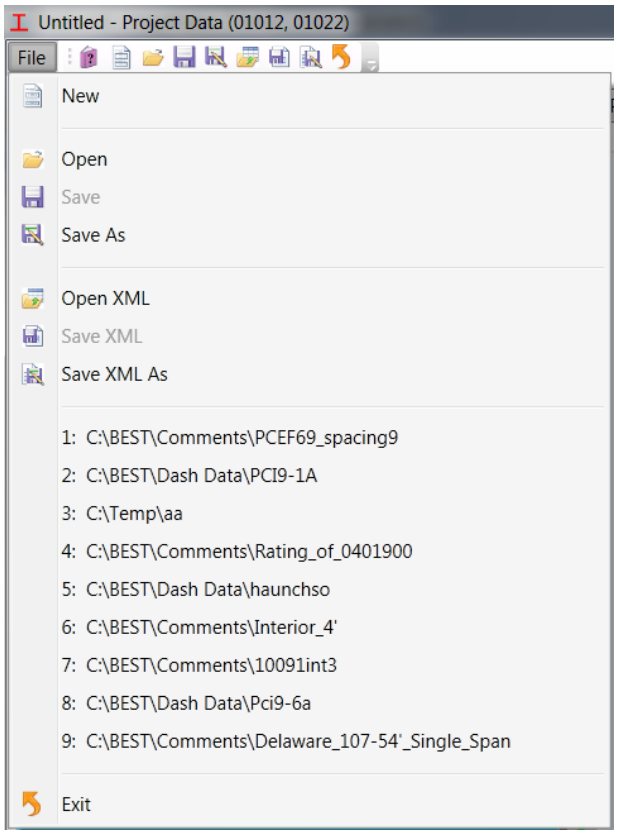
The Input Utility allows you to create new bridge data files or to edit existing files. Once you have entered the details of a structure, you can save it for later use.

While entering data items, different graphics including bridge plan, cross sections, girder profile, tendon configuration, truck illustrations and 3D bridge will be showing on right of the screen so data can be checked visually.

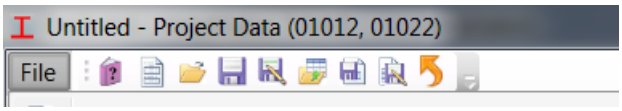
4.1 Main Menu

File Menu

By clicking on ‘File’ a submenu with the options ‘New’, ‘Open’, ‘Save’, ‘Save As’, ‘Open XML’, ‘Save XML’, ‘Save XML As’ and ‘Exit’ appears.



Toolbar



	Help	- Open help window
	New	- Create a new DASH input project.
	Open	- Open an existing DASH input data file
	Save	- Save current DASH input project as a DASH input data file
	Save As	- Save current DASH input project as a different DASH input data file
	Open XML	- Open an existing DASH XML file
	Save XML	- Save current DASH input project as a DASH XML file
	Save XML As	- Save current DASH input project as a different DASH XML file
	Exit	- Quit the Input Utility

Most Recent Files:
Items listed between **Save XML As** and **Exit** are most recent files accessed by the Input Utility. Click any one of them to open it directly.

Tips: DASH input data file or DASH XML file?

DASH input data file is the input file for DASH analysis program. It is fundamental to run the DASH program. DASH XML file has more information than DASH input data file has. For example, in the current release, DASH input data file does not contain cross sectional tendon configurations of a Prestressed Concrete structure; while DASH XML file does contain all data.

DASH XML file takes more space and takes more time to load. If a structure is not Prestressed Concrete, keep DASH input file only. For a PC structure, always keep XML file to retain cross sectional tendon configuration. When ready to run DASH analysis program, save a copy of DASH input data file.

For a PC structure, when a project is read directly from DASH data input file, missed cross sectional tendon configuration will be faked by assuming tendons are equally spaced in lateral by a default spacing.

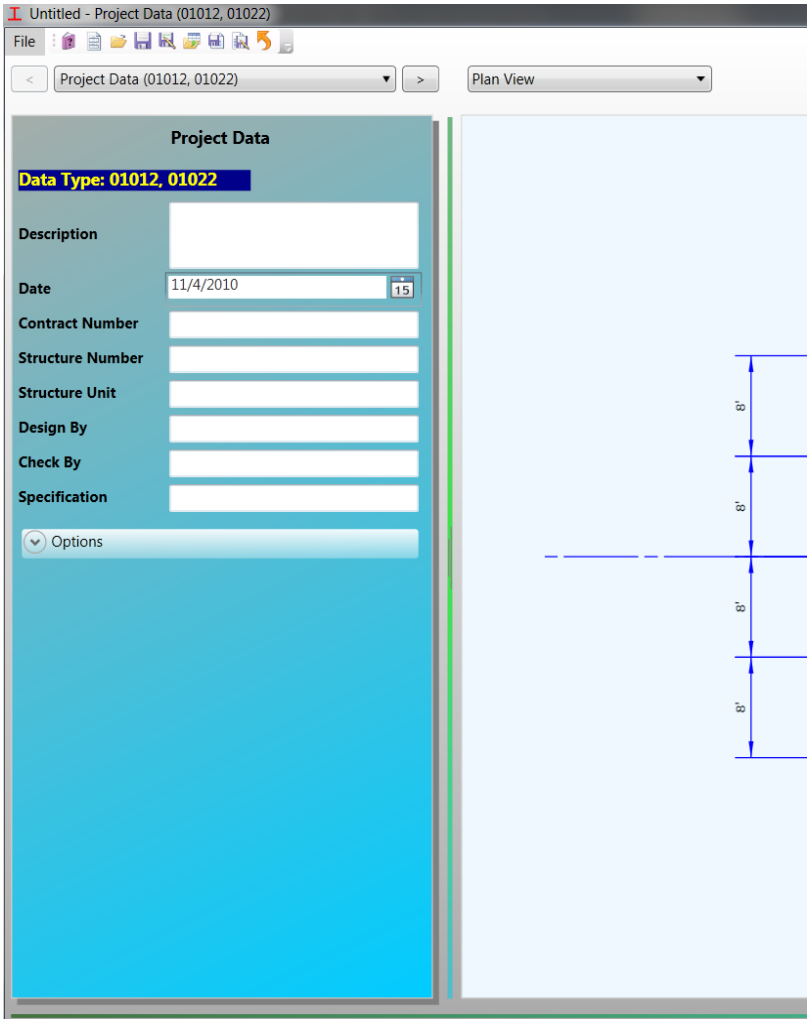
4.2 Data Input Pages

Input Data for DASH program are grouped by different Data Types. Each data type has a data type number and a name. In the Input Utility, data input for each data type are grouped together by a **Data Input Page**.

Data Input Pages are grouped by their purposes.

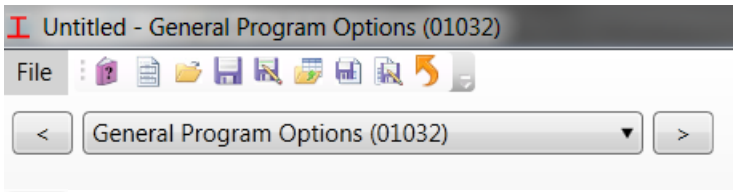
The available **Data Input Page** groups are **System**, **Structure Framing**, **Beam Definition**, **Factor Definition, Live Load**, **Dead Load**, **Design**, **Details and Property** etc.

Data Input Pages are shown on the left side of the window. The following screen capture shows **Project Data** input page on the left. To enter DASH data, you need to Navigate to a Data Input Page First.



Navigate to a Data Input Page

Controls beneath Toolbar are for navigation between Data Input Pages.

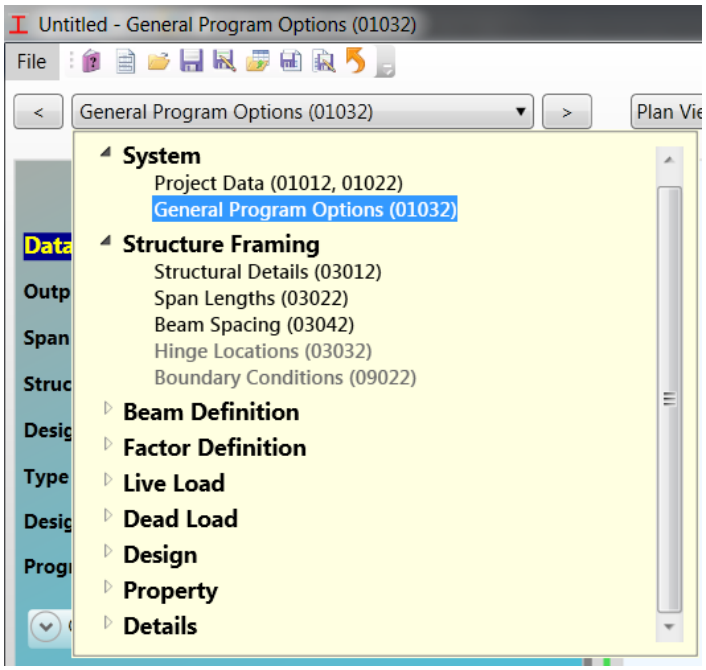


Go previous page

Drop down page list to select a page

Go next page

When page list drops down by clicking any where over the middle control, the following window will pop up. Double click over any bold item in the window to expand/collapse a group of Data Input Pages. Double click over any page item to go to that page.



4.2.1 System

System group contains Project Data (Data Types 01012 and 01022) and General Program Options (Data Type 01032). This group is for all structure types.

4.2.1A Project Data (Data Type 01012, 01022)

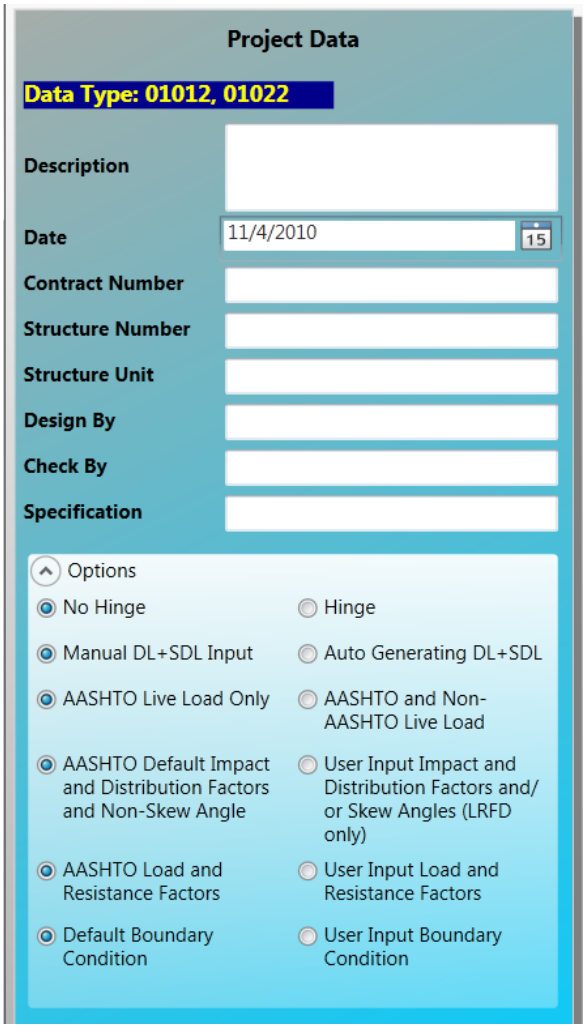


Table 4.1 : Project Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
01012	**Project Data (1)**				
	General Description of Project	**NONE**	**ALPHA**	**OPT.**	
	Date	**NONE**	**ALPHA**	**OPT.**	
01022	**Project Data (2)**				
	General Description of Project	**NONE**	**ALPHA**	**OPT.**	
	Contract Number				
	Structure Number	**NONE**	**ALPHA**	**OPT.**	
	Structure Unit	**NONE**	**ALPHA**	**OPT.**	
	Designed By	**NONE**	**ALPHA**	**OPT.**	
	Checked By	**NONE**	**ALPHA**	**OPT.**	
	Specification Used	**NONE**	**ALPHA**	**OPT.**	

4.2.1B General Program Options (Data Type 01032)

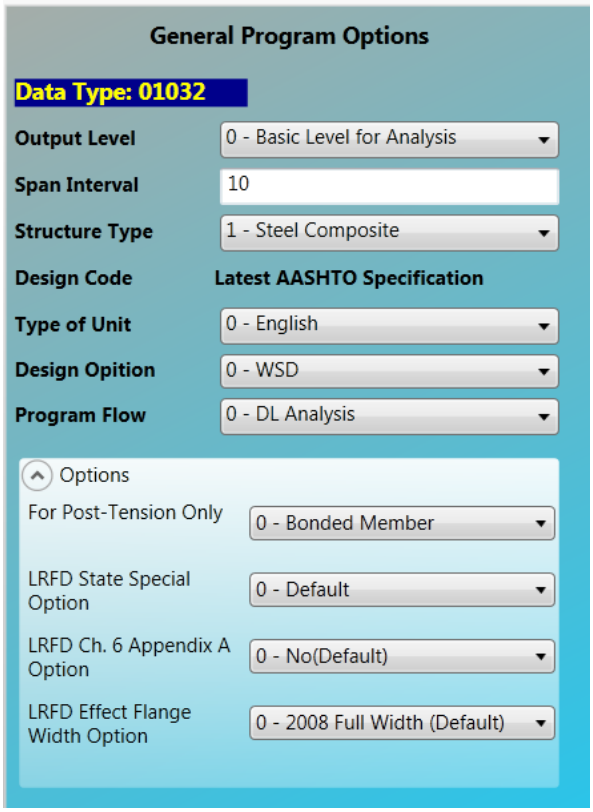


Table 4.2 : General Program Options Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
01032	**General Program Options**				
	Output Level: 0 = Basic **(Default)** 1 = Detailed	**NONE**	**INT.**	**REQ.**	**T. 7.2**
	Span Interval: Number of equally spaced intervals (usually given between 10 and 20) into which the spans are to be divided for output. Maximum = 20.	**NONE**	**INT.**	**REQ.**	**T. 2.3**
	Structural Type: 1 = Steel Composite (Default) 2 = Steel Non-Composite 3 = Reinforced Concrete 4 = Prestressed Concrete	**NONE**	**INT.**	**REQ.**	
	Type of Units: 0 = US Customary 1 = SI 2 = SI input, US Customary output, 3 = US Customary input, SI output	**NONE**	**INT.**	**OPT.**	
	Design Code Option: 0 = WSD **(Default)** 1 = LFD 2 = LRFD	**NONE**	**INT.**	**REQ.**	
	Program Flow Control: This is used to define the Flow of the program as follows: 0 = DL ANALYSIS ONLY **(Default option)** 1 = DL + LL ANALYSIS 2 = CODE CHECK 3 = RATING 4 = DESIGN 6 = DESIGN + RECYCLE + CODE CHECK 7 = DL STAGE ANALYSIS 8 = DL STAGE + LL ANALYSIS	**NONE**	**INT.**	**REQ.**	**FIG. 2.1**
	For Post-Tension Tendon only 0 = Bonded member, 1 = Unbonded member	**NONE**	**INT**.	**OPT.**	

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
01032	***LRFD State Special Option***	**NONE**	**INT.**	**OPT.**	
(cont.)	Enter 0 or blank for no LRFD state special option				
	Enter 1 for MN DOT option for neg. LLM factor				
	0.9 if span length < 100’				
	1.1 if span length > 200’				
	Interpolate in between				
	Enter 2 for MI DOT option for HL-93 * 1.2				
	LRFD Ch.6 Appendix A Option	**NONE**	**INT.**	**OPT.**	
	0 – Default (No)				
	1 – Yes				
	LRFD Effective Flange Width Option	**NONE**	**INT.**	**OPT.**	
	0 – Default (2008 full width)				
	1 – ‘Prior to 2007’ width.				

Please refer to Appendix A-5 for Screen Organizer.

4.2.2 Structure Framing

Structure Framing group contains Structure Detail (Data Type 03012), Beam Spacing (Data Type 03042) and Hinge Location (Data Type 03032) for all structure types and Span Length (Data Type 03022) for non-PC structures, Span Length (Data Type 03062) for PC structures, and Boundary Condition (Data Type 09022) for steel structures.

4.2.2A Structural Details (Data Type 03012)

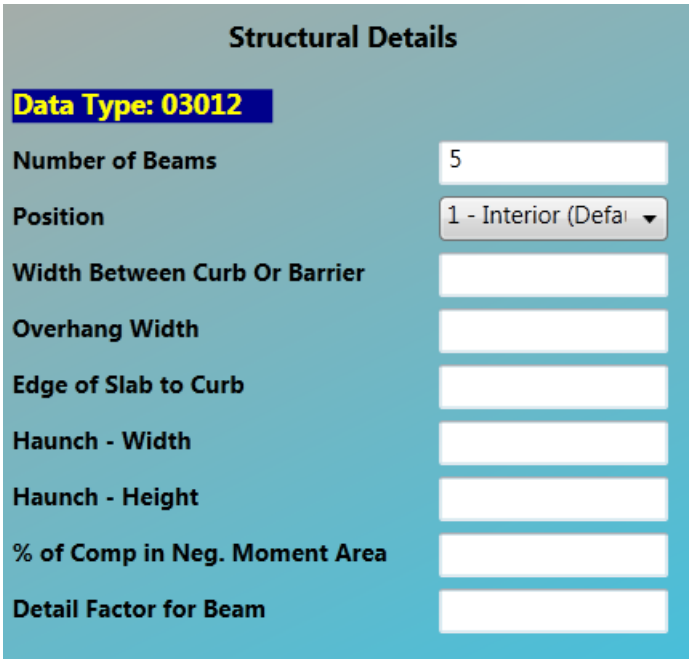


Table 4.3 : Structural Details Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
03012	***Number of Beams:*** Number of beams within the bridge cross section. This is used to compute the live load distribution factor for an exterior beam according to the design code specified on *DATA TYPE* 01032, and to average the live load deflections.	**NONE**	**INT.**	**REQ.**	**T. A.1.2**
	Position*:* This is used in determining the LL distribution factor and in the application of any sidewalk live loading: 1 = Interior **(Default)** 2 = Exterior	**NONE**	**INT.**	**REQ.**	**T. A.1.2**
	Width Between Curb and Barrier: Distance between curbs or barriers. This parameter is used in determining the traffic lane division for the exterior beam live load distribution factor.	**ft (m)**	**REAL**	**REQ.**	**T. A.1.2**

(continued)

Table 4.3 : Structural Details Input Description *(continued)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
03012 ***(cont.)***	**NOTE:** Median barriers are considered movable and, therefore, are not accounted for in the determination of the LL distribution factor for an exterior beam **OPTION:** An option which allows the engineer to specify the distribution factor is available via DATA TYPE 08XXX.				
	Overhang Width: The distance from the centerline of an exterior beam or girder to the outside edge of the bridge.	**ft (m)**	**REAL**	**REQ.**	**T. A.1.2**
	Edge of Slab to Curb: The distance from the outside edge of the bridge to the curb line.	**ft (m)**	**REAL**	**REQ.**	**T. A.1.2**
	Haunch, Depth, Width : The dimensions of the haunch which is used in computing the section properties of composite sections. Leave blank for non-composite construction. (Haunch depth is from top of the steel web to the bottom of the slab)	**in (mm)**	**REAL**	**OPT.**	**T. A.1.2**
	Percent Composite in Negative Moment Area : Extent of composite action assumed for the DL negative moment region (for the generation of the stiffness matrix). This item is expressed as a decimal percentage (i.e., 0.0% through 100%); leave blank for non-composite. construction. **Default = 100 %**	**%**	**REAL**	**OPT.**	**T. A1.2**
	Detail Factor for Beam : A factor used as a multiple of the DL of the basic beam for or plate girder sections to account for such details as connections, cross-frames, hangers, etc. **Default = 1.0**	**NONE**	**REAL**	**OPT.**	**T. A1.2** **T. 2.4**

4.2.2B Span Length (For non-PC Bridge) (Data Type 03022)

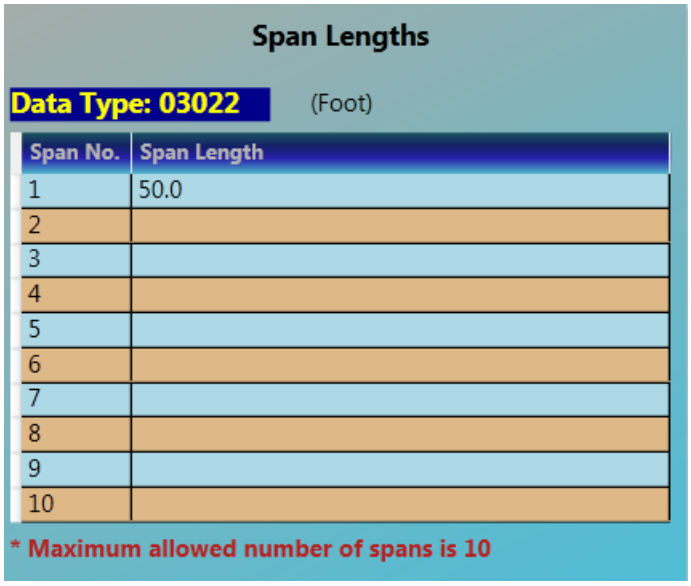


Table 4.4 : Span Lengths Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
03022	***Span 1 Lengths. Span N Lengths:*** The length of each span up to a maximum of 10 spans.	**ft (m)**	**REAL**	**REQ.**	**T. 2.3**

4.2.2C Span Length (for PC Bridge only) (Data Type 03062)

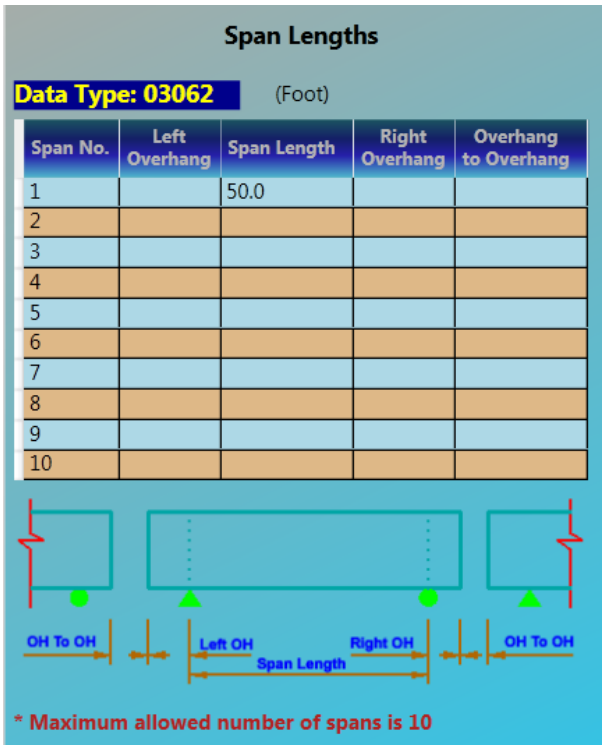
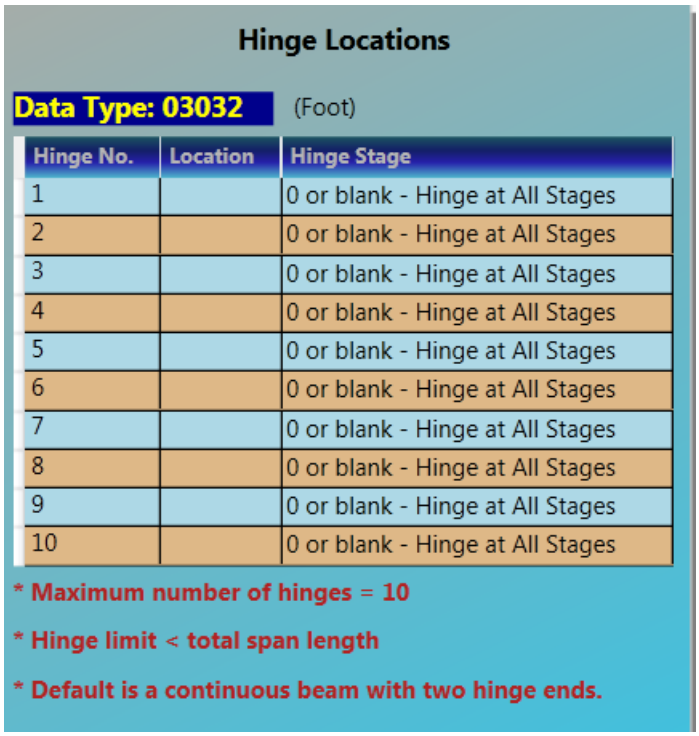


Table 4.4.A : Span Lengths Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
03062	**Left Overhang:** Distance of left overhang from left bearing	ft (m)	REAL	REQ.	
	Span 1 Lengths. Span N Lengths: The length of each span up to a maximum of 10 spans.	ft (m)	REAL	REQ.	
	Right Overhang: Distance of right overhang from right bearing	ft (m)	REAL	REQ.	
	Overhang to Overhang: Gap distance between overhangs at the interior pier	ft (m)	REAL	REQ.	

Note: Total length referred to in the input is based on the sum of the span lengths only. Program will adjust the total length including overhang lengths.

4.2.2D Hinge Locations (Data Type 03032)



Hinge Locations

Data Type: 03032 (Foot)

Hinge No.	Location	Hinge Stage
1		0 or blank - Hinge at All Stages
2		0 or blank - Hinge at All Stages
3		0 or blank - Hinge at All Stages
4		0 or blank - Hinge at All Stages
5		0 or blank - Hinge at All Stages
6		0 or blank - Hinge at All Stages
7		0 or blank - Hinge at All Stages
8		0 or blank - Hinge at All Stages
9		0 or blank - Hinge at All Stages
10		0 or blank - Hinge at All Stages

* Maximum number of hinges = 10

* Hinge limit < total span length

* Default is a continuous beam with two hinge ends.

Table 4.5 : Hinge Locations Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
03032	***Hinge Locations*** Distance from the extreme left support (left bearing location) Note: maximum number of hinges = 10 and hinge location limit should be less than the total span length Note: The current version only allows hinges at the pier supports. Distance of the hinge location is the accumulation of the span lengths defined in Data Type 03062, not including overhangs.	**ft (m)**	**REAL**	**REQ**	
	Hinge ID 0 or blank – Hinge at All Stage 1 – Hinge at DL Stage 2 – Hinge at Superimposed DL Stage 3 – Hinge at LL Stage (Hinge ID = 1 for simple-span-for-dead-load-and-continuous-span-for-line-load case applied to either PC or Steel bridges)	**NONE**	**INT.**	**REQ**	

4.2.2E Beam Spacing (Data Type 03042)

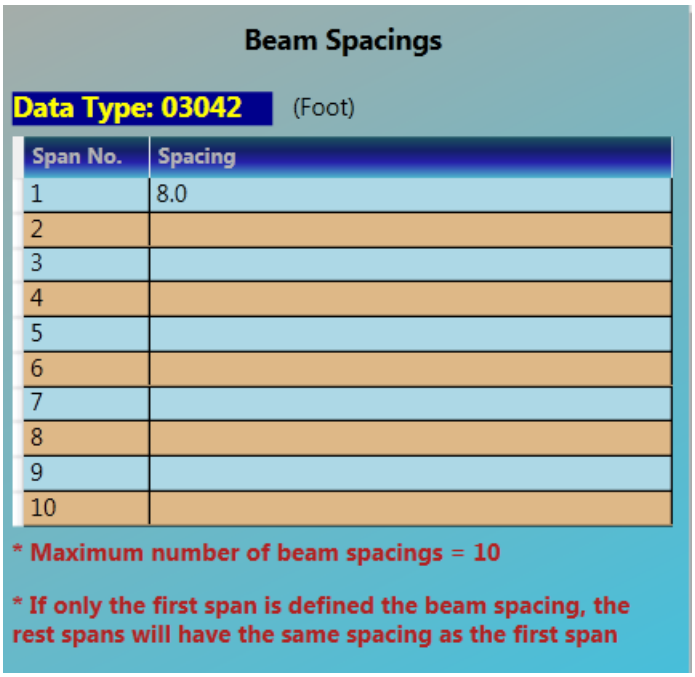
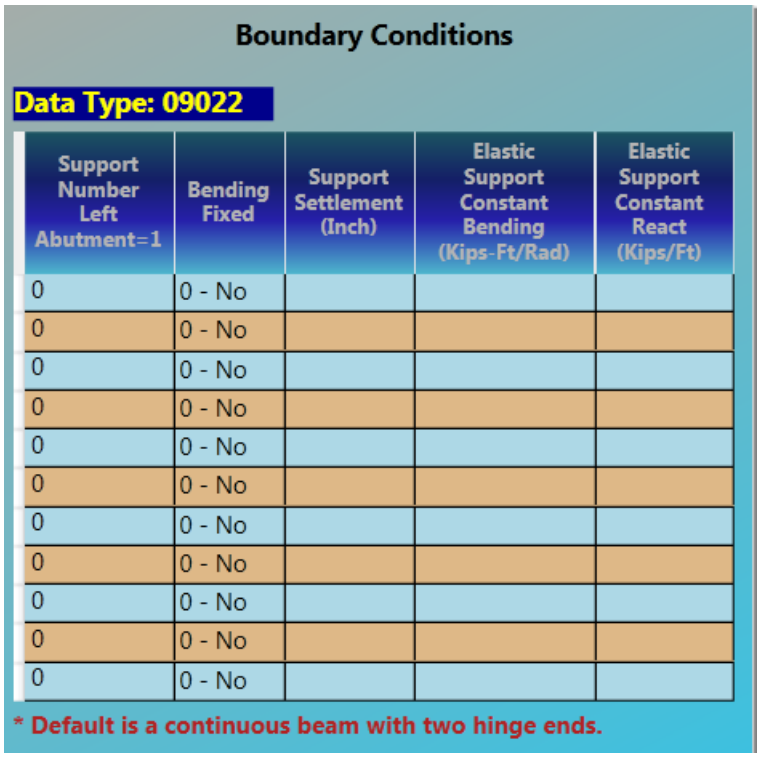


Table 4.6 : Beam Spacing Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
03042	***Span 1 Beam Spacing. . Span N Spacing:*** The beam spacing for each span. These data are used to compute the LL distribution factor.	**ft (m)**	**REAL**	**REQ.**	

4.2.2F Boundary Conditions (Data Type 09022)



Boundary Conditions

Data Type: 09022

Support Number Left Abutment=1	Bending Fixed	Support Settlement (Inch)	Elastic Support Constant Bending (Kips-Ft/Rad)	Elastic Support Constant React (Kips/Ft)
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			
0	0 - No			

* Default is a continuous beam with two hinge ends.

Table 4.7 : Boundary Conditions Input Description

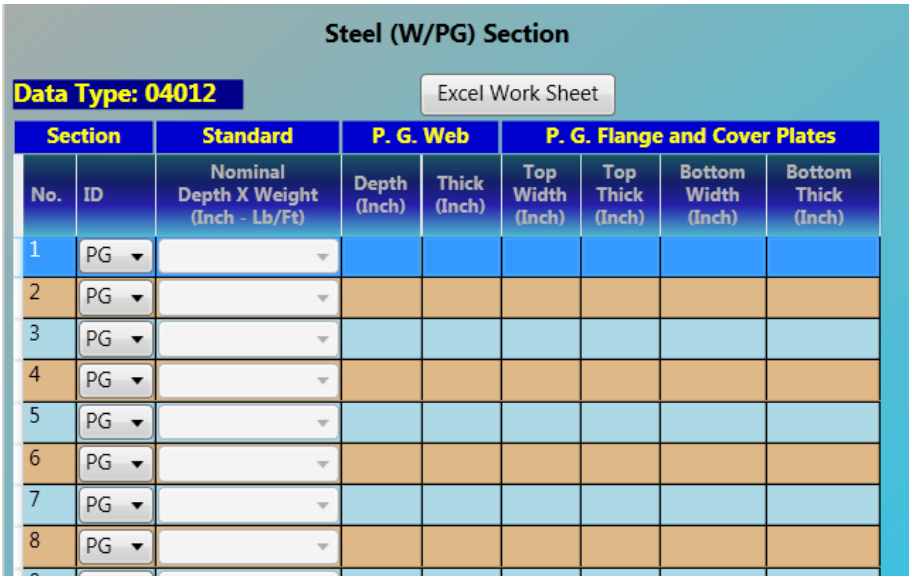
DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
09022	***Support number:*** Support no. Starting from left end as 1.	**NONE**	**INT.**	**OPT.**	
	Bending Fix: Fix support bending if fix = 1, **Default = 0.**	**NONE**	**INT.**	**OPT.**	
	Support Settlement: Vertical downward settlement. (Downward is negative)	**in (mm)**	**REAL**	**OPT.**	
	Elastic Support Constant				
	Bending: Rotational spring constant.	**kip-ft/rad (kN-m/rad)**	**REAL**	**OPT.**	
	Reaction: Vertical spring constant.	**kips/ft (kN/m)**	**REAL**	**OPT.**	

4.2.3 Beam Definition

4.2.3.1 Steel

Beam Definition for steel bridge contains Steel (W/PG) Section (Data Type 04012) and Definition of Members (Data Type 05012).

4.2.3.1A Wide Flange, Plate Girder (Data Type 04012)



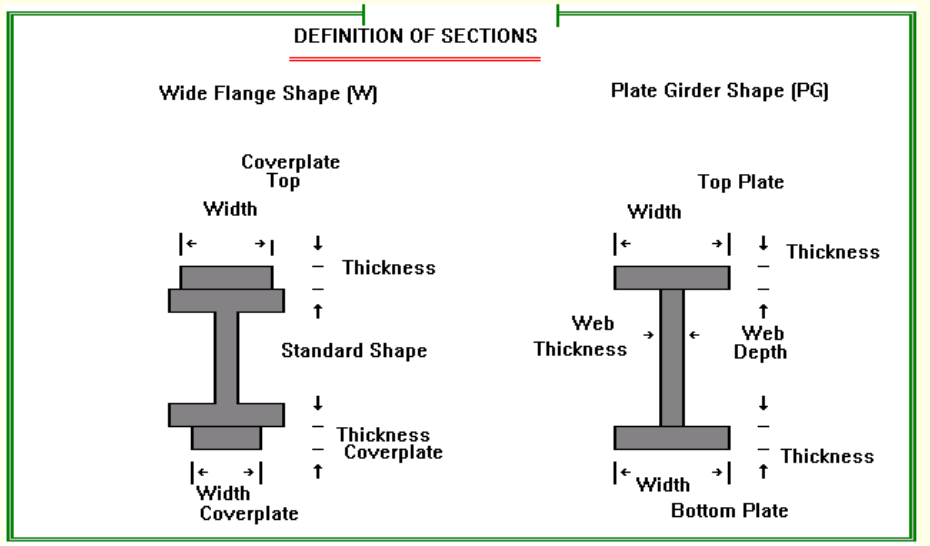


Table 4.8: Flanged Sections Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04012	**For Steel Section:**				
	Section Number: Cross sections are defined for each change in cross-section and are defined for both the left and right end member range. *(SEE DATA TYPE 05012).* Each discrete cross section is not numbered if it already has been identified with a previous section number. Section numbers begin with the integer 1.	**NONE**	**INT.**	**REQ.**	
	Section Identification: (all upper case letters) W = Wide Flange, Rolled Shape PG = Plate Girder RC = Reinforced Concrete	**NONE**	**ALPHA**	**REQ.**	
	Standard Section, Nominal Depth: Nominal depth of the AISC section. No entry is made for plate girders.	**in (mm)**	**INT.**	**OPT.**	**REF.2**
	Standard Section, Weight: Nominal weight of the AISC section. No entry is made for plate girders.	**lb/ft (kN/m)**	**REAL**	**OPT.**	**REF.2**
	Plate Girders, Web Depth and Thickness: Web depth and thickness of the plate girder. No entry is made for standard rolled beams.	**in (mm)**	**REAL**	**OPT.**	
	Plate Girders and Standard Sections With Cover Plates, Top/Bottom Plate Width and Thickness: The width and thickness of the top/bottom plate. This will be taken as the top/bottom flange dimensions for a plate girder and the top/bottom cover plate dimension for a standard rolled section.	**in (mm)**	**REAL**	**OPT.**	
	Moment of Inertia for Reinforced Concrete: This input is used if RC option is selected.	**in^4 (mm^4)**	**REAL**	**OPT.**	
	Area for Reinforced Concrete: This input is used if RC option is selected.	**in^2 (mm^2)**	**REAL**	**OPT.**	

4.2.3.1B Definition of Members (Data Type 05012)

Definition of Members

Data Type: 05012 Excel Work Sheet

Member	Sections		Parameters				Yield Strength (Ksi)		
No.	Number Left	Number Right	Length (Foot)	Type	S0	S1	Web	Top Flange	Bottom Flange
1				0 - Prismatic					
2				0 - Prismatic					
3				0 - Prismatic					
4				0 - Prismatic					
5				0 - Prismatic					
6				0 - Prismatic					
7				0 - Prismatic					
8				0 - Prismatic					
9				0 - Prismatic					
10				0 - Prismatic					
11				0 - Prismatic					
12				0 - Prismatic					
13				0 - Prismatic					
14				0 - Prismatic					
15				0 - Prismatic					
16				0 - Prismatic					
17				0 - Prismatic					
18				0 - Prismatic					
19				0 - Prismatic					
20				0 - Prismatic					

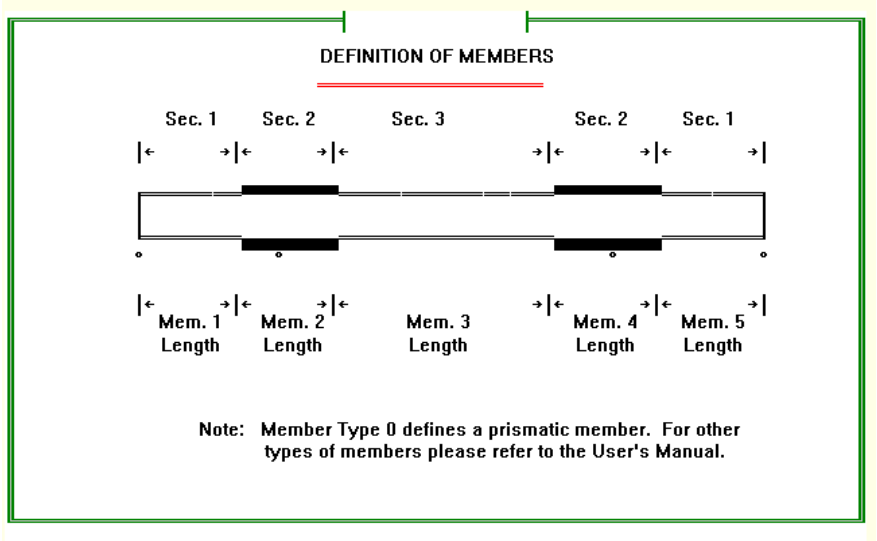
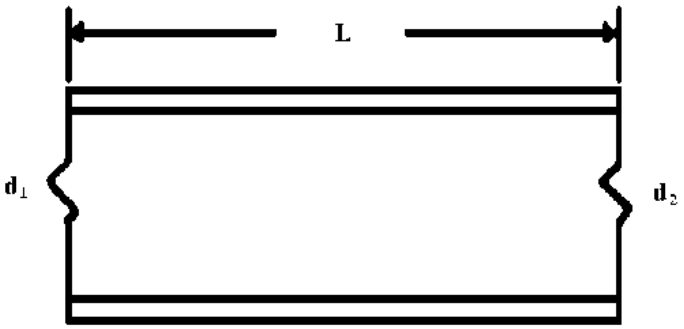


Table 4.9: Definition of Members Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
05012	A member is defined as a range or segment of a plate girder or rolled beam. The members must be numbered and input sequentially along the beam starting at the extreme left support. Members are defined between section numbers. Thus, a member ranges from a left section number to a right section number which may be the same or different. Members may consist of several possible prismatic or non-prismatic configurations of different lengths. A detailed description of this input is given as follows : If design option is chosen, no member needs to be specified.				
	Member Number : The sequence number of the member (or range) numbered from the leftmost point on the bridge.	**NONE**	**INT.**	**REQ.**	
	Section Number L, R: These define the beginning and ending cross-sections of the member. Input the section number found at the extreme left and right ends of the member. These section numbers correspond to those input on *DATA TYPE 04012.*	**NONE**	**INT.**	**REQ.**	
	Member Type: 0 = Prismatic **(Default)** 1 = Linear 2 = Parabolic (Concave Down) 3 = Parabolic (Concave Up)	**NONE**	**INT.**	**OPT.**	**T.A.1.3**
	Member Parameters:				
	Length : Length or range of the member.	**Ft (m)**	**REAL**	**REQ.**	**T.A.1.3**
	S0 & S1 : These two parameters correspond to different constants that must be defined for a non- prismatic member. Leave blank for a prismatic member.	**in/ft^2 (mm/m^2)**	**REAL**	**OPT.**	**T.A.1.3**
	Steel Yield Stress of the Web Element for the Hybrid section	**Ksi (MPa)**	**REAL**	**OPT.**	
	Steel Yield Stress of the Top Flange for the Hybrid section	**Ksi (MPa)**	**REAL**	**OPT.**	
	Steel Yield Stress of the Bottom Flange for the Hybrid section	**Ksi (MPa)**	**REAL**	**OPT.**	

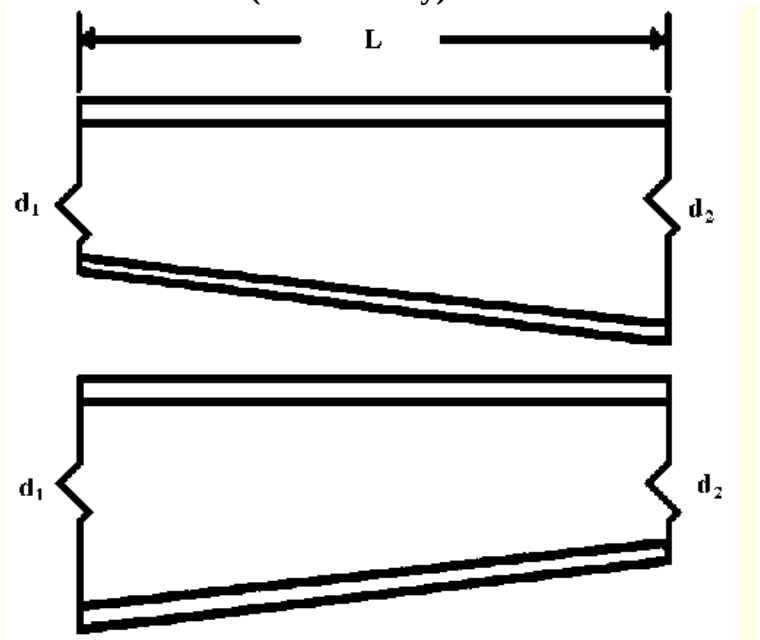
Member Type:

0 = Prismatic (Default)

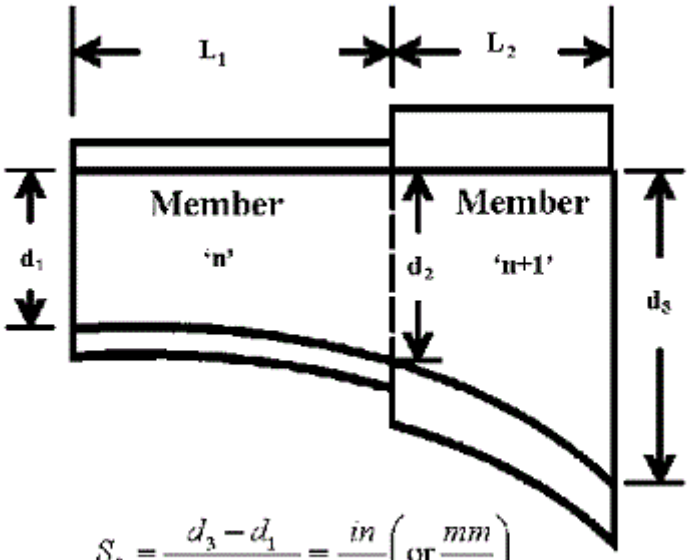


L = member length
d_1 = depth at left end
d_2 = depth at right end

1 = Linear (for steel only)



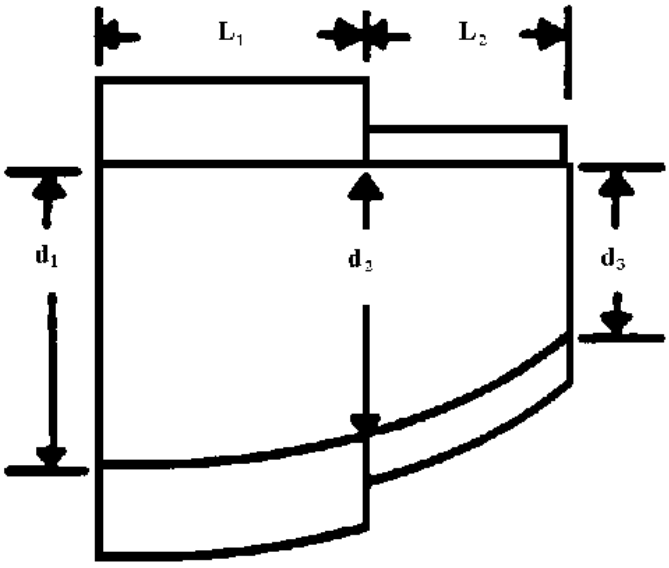
2 = Parabolic (Concave Down) (for steel only)



$$S_0 = \frac{d_3 - d_1}{(L_1 + L_2)^2} = \frac{in}{ft^2}\left(\text{or } \frac{mm}{m^2}\right)$$

$$S_1 = l_1 + l_2 = ft(\text{or } m)$$

3 = Parabolic (Concave Up) (for steel only)



$$S_0 = \frac{d_3 - d_1}{(L_1 + L_2)^2} = \frac{in}{ft^2}\left(\text{or } \frac{mm}{m^2}\right)$$

$$S_1 = L_1 + L_2 = ft(\text{or } m)$$

4.2.3.2 Reinforced Concrete

Beam Definition for reinforce concrete bridge contains RC Section (Data Type 04012),RC Reinforcement Details (Data Type 04022) and Definition of Members (Data Type 05012).

4.2.3.2A RC Section (Data Type 04012)

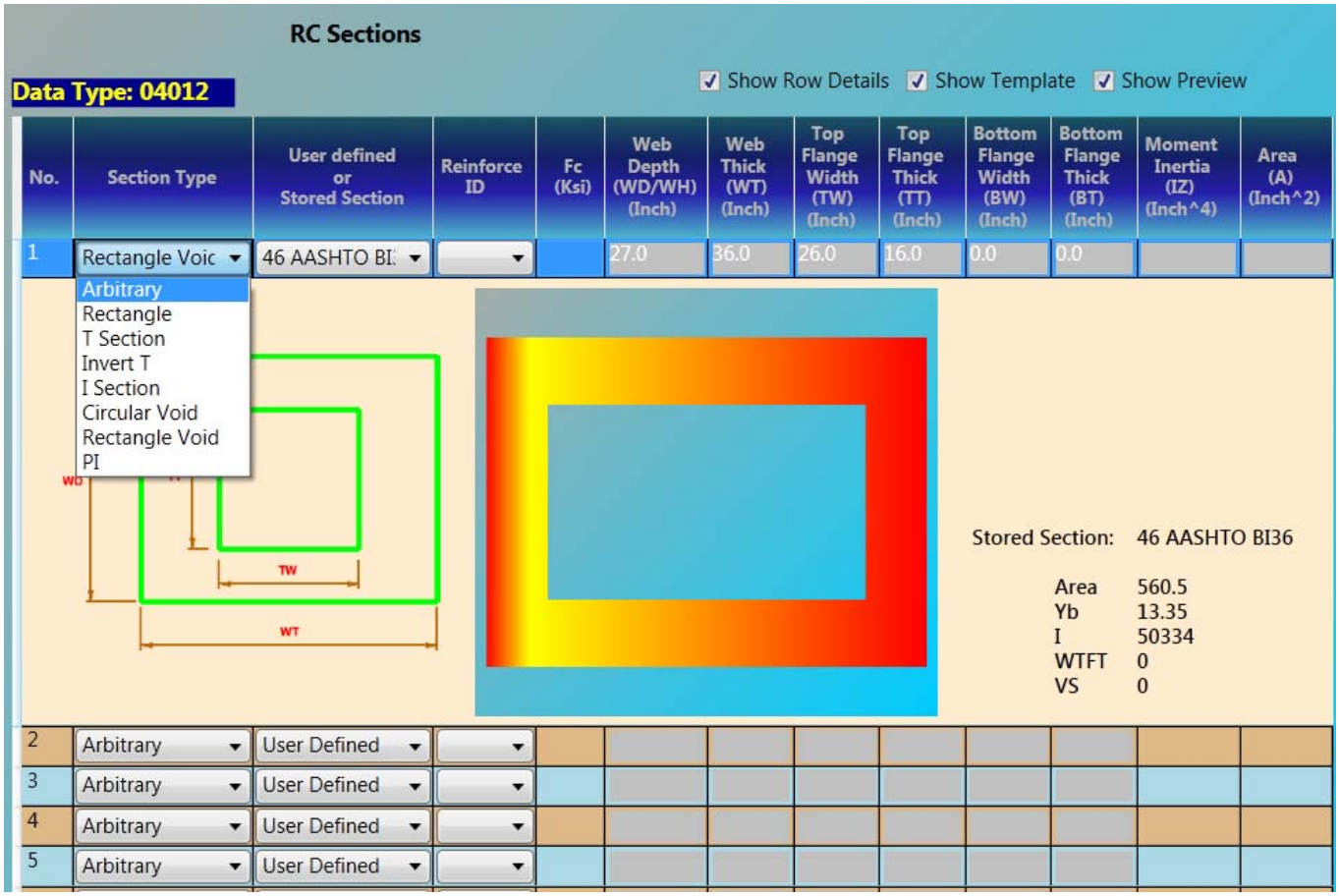


Table 4.10 : Reinforced Concrete Sections Input Descriptions

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04012	**For Reinforced Concrete Sections Only:**				
	Section Number: Cross sections are defined for each change in cross-section and are defined for both the left and right end member range *(SEE DATA TYPE 05012).* Each discrete cross-section does not need to be numbered if it has been identified already with a previous section number. Section numbers begin with the integer 1.	**NONE**	**INT.**	**REQ.**	
	Section Type: 0 = User defined arbitrary 1 = Solid Rectangular (or slab) 2 = T-Beam 3 = Inverted T-Beam 4 = I-Beam 5 = Circular Voided Slab 6 = Rectangular Voided Slab 7 = PI	**NONE**	**INT.**	**REQ.**	
	User defined or Stored Section: Select User Defined to define a cross section by entering different parameters according to different section type, or select a stored section if there is any predefined section of selected section type.				
	Reinforcement I.D.: This defines the reinforcement of the member. Input reinforcement number defined in Data Type 04022.	**NONE**	**INT.**	**REQ.**	
	Concrete Strength (F 'c): The 28-day compressive strength of concrete section.	**ksi (MPa)**	**REAL**	**REQ.**	
	Web Depth and Thickness: Thickness and depth of the web for the types 2, 3 and 4. Thickness and depth of the section for the types 1, 5 and 6. For type 0 (analysis only) no thickness needed.	**in (mm)**	**REAL**	**REQ.**	

(continued)

Table 4.10 : Reinforced Concrete Sections Input Descriptions *(continued)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04012 ***(cont.)***	***Top Flange Width and Thickness:*** Type = 1 : No input, 2 : Input for top flange, 3 : No input, 4 : Input for top flange, 5 : Input width as the diameter of inner circle, 6 : Input as the width and height of rectangular void.	**in (mm)**	**REAL**	**REQ.**	
	Bottom Flange Width and Thickness: Type = 1 : No input, 2 : No input, 3 : Input for bottom flange, 4 : Input for bottom flange, 5 : No input, 6 : No input.	**in (mm)**	**REAL**	**REQ.**	
	Moment of Inertia : For concrete type 0 only.	**in^4 (mm^4)**	**REAL**	**OPT.**	
	Cross-Section Area : For concrete type 0 only.	**in^2 (mm^2)**	**REAL**	**OPT.**	

4.2.3.2B RC Reinforcement Details (Data Type 04022)

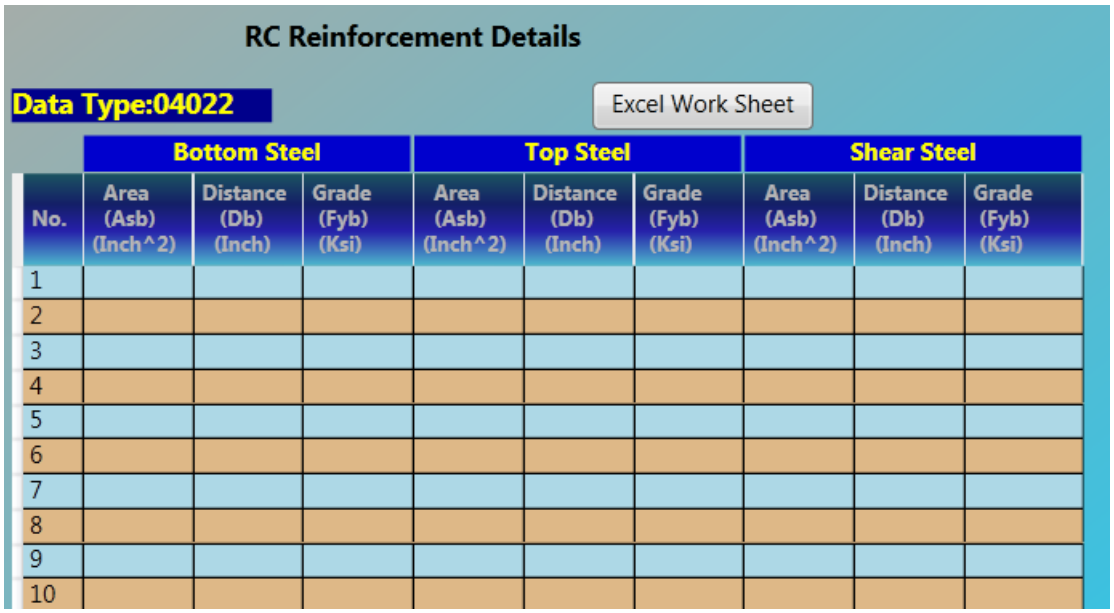


Table 4.11 : Reinforcement of Concrete Sections Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04022	***Reinforcement Number*** *:* Reinforcements defined here are are to be used in DATA TYPE 04012 as reinforcement ID for concrete sections.				
	Bottom, Top and Shear Steel Areas : Total steel areas at the bottom, top and web within the defined section.	**in^2 (mm^2)**	**REAL**	**OPT.**	
	Distances :				
	Distance for bottom steel : Distance from bottom face of the member to the centroid of bottom steel.	**in (mm)**	**REAL**	**REQ.**	
	Distance for Top Steel : Distance from top face of the member to the centroid of top steel.	**in (mm)**	**REAL**	**REQ.**	
	Space for Shear Steel : Spacing between two vertical shear steel.	**in (mm)**	**REAL**	**REQ.**	
	Bottom, Top and Shear Steel Grades (Yield Stress) : Yield stresses of bottom, top and shear steel.	**ksi (MPa)**	**REAL**	**REQ.**	

4.2.3.2C Definition of Members (Data Type 05012 RC)

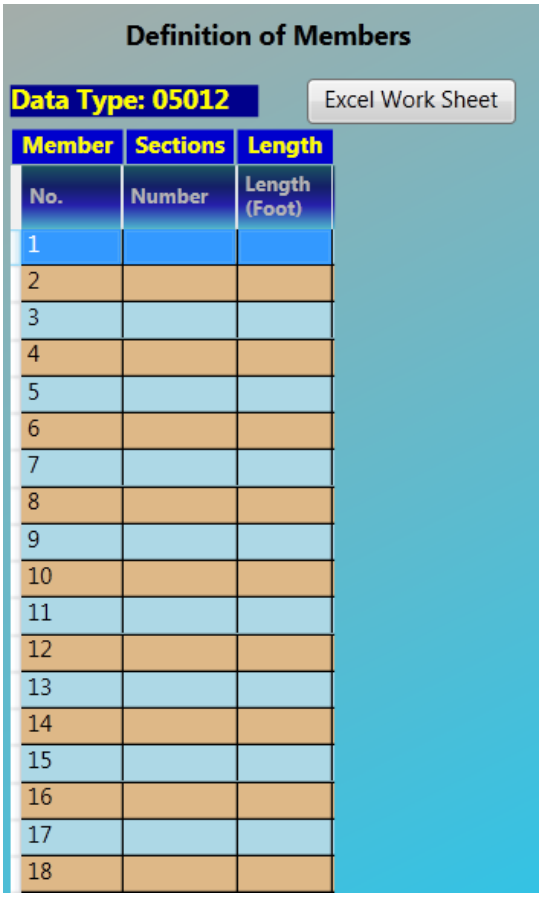


Table 4.12 : Definition of Members Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
05012	A member is defined as a range or segment of a plate girder or rolled beam. The members must be numbered and input sequentially along the beam starting at the extreme left support. Members are defined between section numbers. Thus, a member ranges from a left section number to a right section number which may be the same or different. Members may consist of several possible prismatic or non-prismatic configurations of different lengths. A detailed description of this input is given as follows : If design option is chosen, no member needs to be specified.				
	Member Number : The sequence number of the member (or range) numbered from the leftmost point on the bridge.	**NONE**	**INT.**	**REQ.**	
	Section Number : This defines the cross-sections of the member. This section number corresponds to this input on RC Section (*DATA TYPE 04012).*	**NONE**	**INT.**	**REQ.**	
	Member Length: Length or range of the member.	**ft (m)**	**REAL**	**REQ.**	**T.A.1.3**

4.2.3.3 Prestressed Concrete

Beam Definition for prestressed concrete bridge contains PC Sections (Data Type 04012),PC Reinforcement Details (Data Type 16012) and Definition of Tendons (Data Type 05032)

4.2.3.3A PC Section (Data Type 04012)

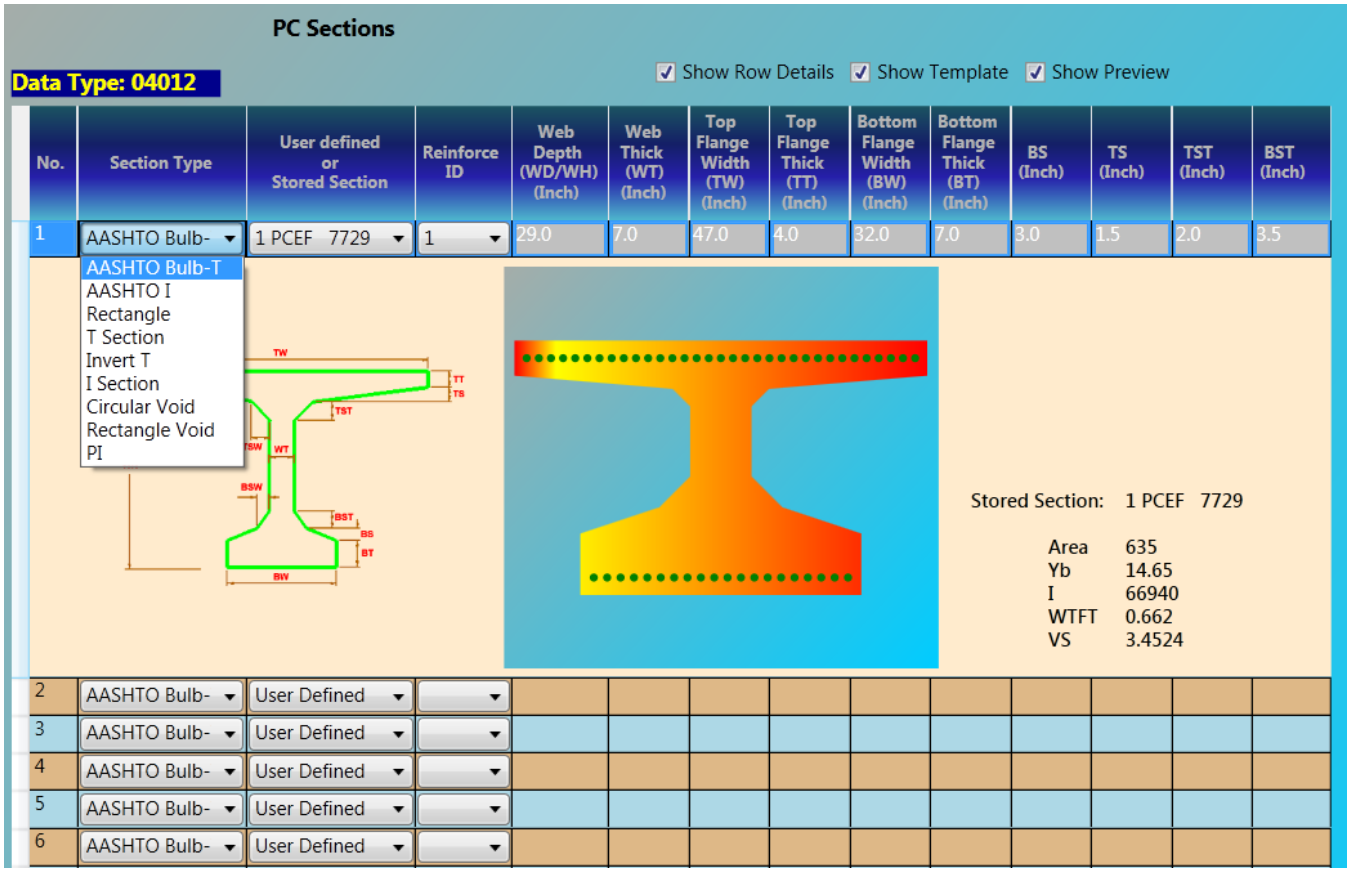


Table 4.13 : PC Sections Input Descriptions

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04012	***Section Number:*** Cross sections are defined for left, middle and right part of a span, which are prismatic within its range. (See Definition of tendons (Data Type 05032). Section numbers begin with the integer 1. It is automatically assigned , user cannot change it.	**NONE**	**INT.**	**REQ.**	
	Section Type: 0 = AASHTO Bulb-T/ AASHTO Bulb-I 1 = Solid Rectangular (or slab) 2 = T-Beam 3 = Inverted T-Beam 4 = I-Beam 5 = Circular Voided Slab 6 = Rectangular Voided Slab 7 = PI	**NONE**	**INT.**	**OPT.**	
	User defined or Stored Section: Select User Defined to define a cross section by entering different parameters according to different section type, or select a stored section if there is any predefined section of selected section type.	**NONE**		**OPT.**	
	Reinforcement I.D.: This defines the reinforcement of the member. Input reinforcement number defined in PC Reinforcement Details (Data Type 16012). According to The steel areas on top and bottom of the section, rebars will be show in section preview and any other pages that Show sections. The vertical locations of rebars truly reflect The rebar distance defined in PC Reinforcement Details (Data Type 16012). Rebars are laid out with an equal spacing Horizontally, center aligned. The number of rebars are defined By a default rebar size.	**NONE**	**INT.**	**REQ.**	
	Web Depth and Thickness, Top Flange Width, Thickness, Bottom Flange Width, Thickness, BS, TS, TST and BST: Enter section parameters for different section types. If a Parameter is not defined for a particular type of section, it Will be disabled. When a stored section is selected, all Parameters will be disabled.	**in (mm)**	**REAL**	**OPT.**	

4.2.3.3B PC Reinforcement Details (Data Type 16012)

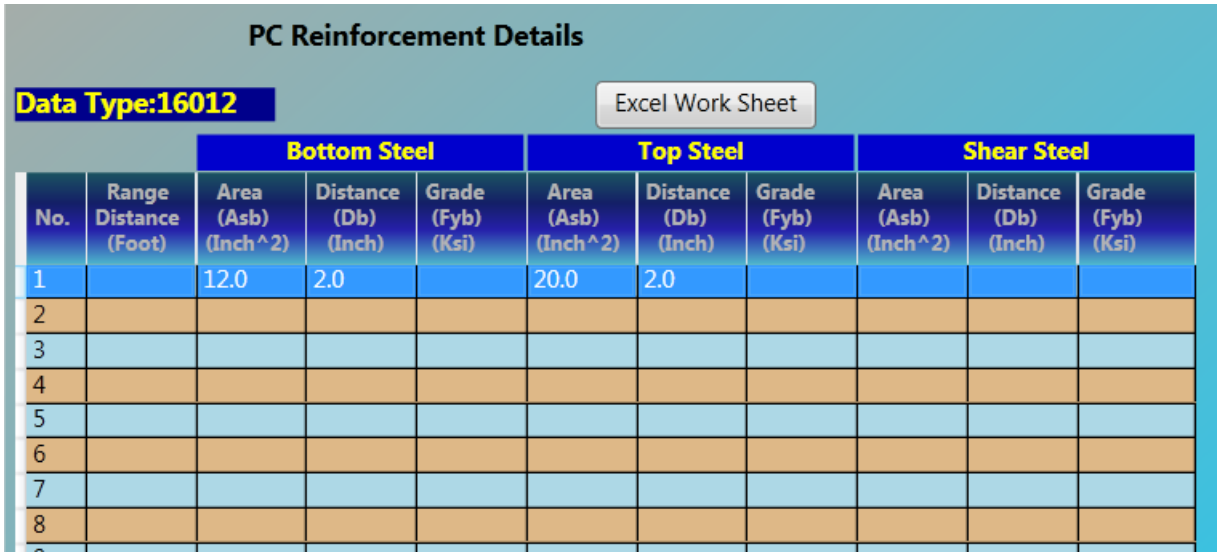


Table 4.14 : PC Reinforcement Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
16012	***Reinforcement Number*** *:* Reinforcements defined here are in ascending order starting from 1 Note: If there is no input for this screen, default shear steel based on #3 bar is designed and used for check and load rating.		**INT.**	**REQ.**	
	Range Distance: Range starting from the 1st to the last spans between supports. For instance, 100'-100' spans can be defined 20'-60'-20' for the first span and the same for the 2nd span for six ranges.	**Foot (m)**	**REAL**		
	Bottom and Top Steel Areas: Total steel areas at the bottom and top within the defined section. (later)	**in^2 (mm^2)**	**REAL**	**OPT.**	
	Shear Steel Areas : Total steel areas at the web within D_b spacing distance	**in^2 (mm^2)**	**REAL**	**OPT.**	
	Distances :				
	Distance for bottom and Top steel : Distances from bottom face of the member to the centroid of bottom steel and from top face to the centroid of top steel, respectively (later)	**in (mm)**	**REAL**	**REQ.**	
	Distance D_b for Shear Steel: Spacing between two vertical shear steel.	**in (mm)**	**REAL**	**REQ.**	
	Bottom, Top and Shear Steel Grades (Yield Stress): Yield stresses of bottom, top and shear steel.	**Ksi (MPa)**	**REAL**	**REQ.**	

4.2.3.3C Definition of Tendons (Data Type 05032)

Definition of Tendons

Data Type: 05032 Excel Work Sheet

Cross Sectional Configurations

Span 1 Copy To Span 2

Rows	Left Section No: 1		Middle Section No: 1		Right Section No: 1	
No.	Distance Between Rows (Inch)	#@Spacings (Inch)	Distance Between Rows (Inch)	#@Spacings (Inch)	Distance Between Rows (Inch)	#@Spacings (Inch)
1	2.0	5@2	2.0	5@2	2.0	5@2
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Tips: When entering tendon column spacings, use C,C,N@D,C,N@D... formats. For example, a row of 5 tendons with equal spacing of 6 inches, enter 4@6; a row of 12 tendons with spacings of 2@5,8,5@6, 8,2@5, enter 2@5,8,5@6,8,2@5; a row of only one tendon, enter 0. Tendons are center aligned.

Longitudinal Definitions

Longitudinal Definitions

Member			Left				Middle			Right			
No.	Span No.	Pattern	Section No.	Raised or Debond Wires	Raised Distance (Inch blank for debond)	Draped or Debond Length (Foot)	Section No.	Total Wires	Distance (Inch blank for debond)	Section No.	Raised or Debond Wires	Raised Distance (Inch blank for debond)	Draped or Debond Length (Foot)
1	1	Pretension - Straight c	1	6	2.0		1	6	2.0	1	6	2.0	
2													

Table 4.15 : Member and Tendon Geometry Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
05032	***No.*:** Span Number, which span the tendon row is for. Starting from 1 to maximum 10 spans. Ready only (defined By Cross Sectional Tendon Configurations)	**NONE**	**INT.**	**REQ**	
	Strand pattern*:* *Wire Code* *1 = Straight or Draped – Pretension,* *2 = Parabolic – Pretension* *3 = Straight – Posttension* *4 = Parabolic – Posttension*	**NONE**	**INT.**	**OPT.**	
	***Span Left*:** For left raised tendon. If no left raised tendon leave this block blank.				(1)
	Section No.: Section number at left end. Read only. (defined by **Cross Sectional Tendon Configurations**).	**NONE**	**INT.**	**OPT.**	
	Raised or Debond Wires: Number of wires raised or debond in left part of a span. Read only (calculated from **Cross Sectional Tendon Configurations**).	**NONE**	**INT.**	**OPT.**	
	Raised Distance: The distance to the bottom of section (inch or mm) at the left end of a span. Read only (calculated from **Cross Sectional Tendon Config.**)	**in (mm)**	**REAL**	**OPT.**	
	Draped or Debond Length: The distance from left end To where the tendon starts draped or debond (foot or meter).	**ft (m)**	**REAL**	**OPT.**	
	***Mid Span*:** For main tendon at mid-span.				(2)
	Section No.: Section number in the middle segment. Read only (defined by **Cross Sectional Tendon Config**.)	**NONE**	**INT.**	**REQ**	
	Total Wires: Total wires in the middles segment. Read only (calculated from **Cross Sectional Tendon Configurations**).	**NONE**	**INT.**	**REQ**	
	Distance: The Distance to the bottom of section (inch Or mm) in the middle segment of a span. Read only (calculated from **Cross Sectional Tendon Config.**)	**in (mm)**	**REAL**	**OPT.**	
	***Span Right*:** For right raised tendon. If no right raised tendon leave this block blank.				(3)
	Section No.: Section number at right end. Read only (defined by **Cross Sectional Tendon Configurations**)	**NONE**	**INT.**	**OPT.**	

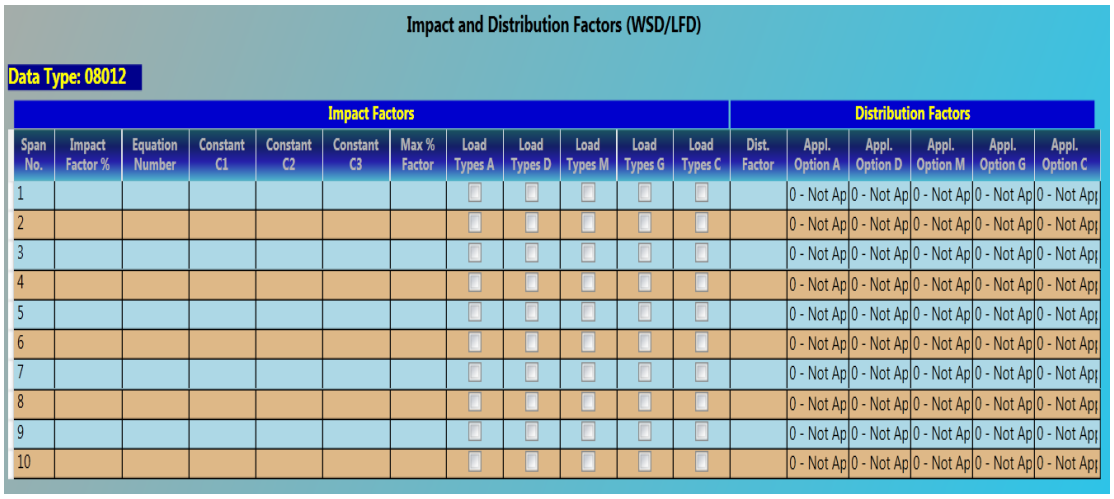
Table 4.15 : Member and Tendon Geometry Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
05032 ***(cont.)***	**Raised or Debond Wires**: Number of wires raised or Debond in right part of a span. Read only (calculated From **Cross Sectional Tendon Configurations**)	**NONE**	**INT.**	**OPT.**	
	Raised Distance: The distance to the bottom of section (inch or mm) at the right end of a span. Read only (calculated from **Cross Sectional Tendon Config.**)	**in (mm)**	**REAL**	**OPT.**	
	Draped or Debond Length: The distance from right end To where the tendon starts draped or debond (foot or Meter).	**ft (m)**	**REAL**	**OPT.**	
	Note: Tendon input can be per row basis with the distance as the row distance or per group of rows basis with the distances as the centroid of the tendon group. Tendon group can be raised or unraised group.				

4.2.4 Factor Definition

Factor Definition for WSD/LFD contains Impact and Distribution Factors (WSD/LFD) (Data Type 08012) and Gamma and Beta (LFD) (Data Type 09012). For LRFD, it contains Impact and Distribution Factors (LRFD) (Data Type 08012) and Load and Resistance Factors (LRFD) (Data Type 09012).

4.2.4A Impact and Distribution Factors (WSD/LFD) (Data Type 08012)



4.2.4B Impact and Distribution Factors (LRFD) (Data Type 08012)

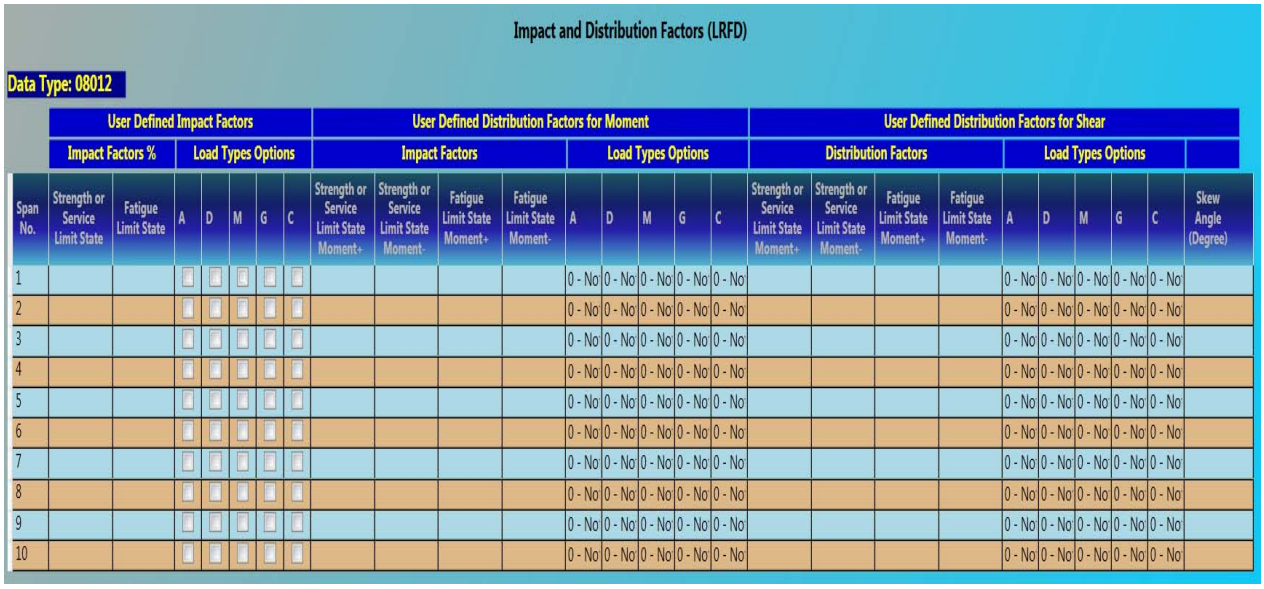


Table 4.16: Impact and Distribution Factors Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
08012	**Specifications of Impact and Distribution Factors** ****For LRFD OPTION, 'AXLE' DISTRIBUTION FACTORS SHOULD BE INPUT. FOR OTHERS, 'WHEEL' DISTRIBUTION FACTORS ARE REFERRED.** The input given here is optional and may be used to override impact and distribution factors which are calculated automatically by the program in accordance with the AASHTO code.				

Table 4.16 : Impact and Distribution Factors Input Description *(continued)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
08012 ***(cont.)***	***Span Number:*** This indicates the span for which impact factor and/or distribution factor information is given. A span number may be repeated as often as needed to input impact and distribution factor data.	**NONE**	**INT.**	**OPT.**	
	Impact Factor: This input will override the impact factor which normally would be computed automatically by the program for the indicated span. The impact value input will be taken as a fixed value independent of loaded Lengths as specified by AASHTO.	**NONE**	**REAL**	**OPT.**	
	NOTE: Alternatively, the standard AASHTO equation for impact may be modified or another equation defined through the use of the Calculation Factor Options as described below.				**T.A.1.5**
	Calculation of Factor, Equation Number: This refers to a specific equation available for the computation of the live load impact factor. This equation can take many forms and is a function of the loaded length. The various equations available within the system are defined in Table A.1.5 - FORMULATION OF THE IMPACT FACTOR.	**NONE**	**INT.**	**OPT.**	**T.A1.5**
	Constants C1, C2, C3: Constants used to define fully the Special impact factor equation. (See TABLE A.1.5 for a complete description.)	**NONE**	**REAL**	**OPT.**	**T.A.1.5**
	<u>For LRFD Option:</u> ***If DF application option is equal to 2 for moment :*** The moment distribution factor of the strength/service limit state in the negative moment area (fix format using as C1). The moment distribution factor of the fatigue limit state in the positive moment area (fix format using as C2). The moment distribution factor of the fatigue limit state in the negative moment area (fix format using as C3). ***If the DF application option is equal to 3 for shear :***				

Table 4.16 : Impact and Distribution Factors Input Description *(continued)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
08012 ***(cont.)***	***Span Number:*** This indicates the span for which impact factor and/or distribution factor information is given. A span number may be repeated as often as needed to input impact and distribution factor data.	**NONE**	**INT.**	**OPT.**	
	Impact Factor: This input will override the impact factor which normally would be computed automatically by the program for the indicated span. The impact value input will be taken as a fixed value independent of loaded Lengths as specified by AASHTO.	**NONE**	**REAL**	**OPT.**	
	NOTE: Alternatively, the standard AASHTO equation for impact may be modified or another equation defined through the use of the Calculation Factor Options as described below.				**T.A.1.5**
	Calculation of Factor, Equation Number: This refers to a specific equation available for the computation of the live load impact factor. This equation can take many forms and is a function of the loaded length. The various equations available within the system are defined in Table A.1.5 - FORMULATION OF THE IMPACT FACTOR.	**NONE**	**INT.**	**OPT.**	**T.A1.5**
	Constants C1, C2, C3: Constants used to define fully the Special impact factor equation. (See TABLE A.1.5 for a complete description.)	**NONE**	**REAL**	**OPT.**	**T.A.1.5**
	<u>For LRFD Option:</u> ***If DF application option is equal to 2 for moment :*** The moment distribution factor of the strength/service limit state in the negative moment area (fix format using as C1). The moment distribution factor of the fatigue limit state in the positive moment area (fix format using as C2). The moment distribution factor of the fatigue limit state in the negative moment area (fix format using as C3). ***If the DF application option is equal to 3 for shear :***				

Table 4.16 : Impact and Distribution Factors Input Description *(continued)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
08012 *(cont.)*	**For WSD/LFD Option:** ***Distribution Factor:*** This value will override the distribution factor computed automatically by the program for the given span. This special distribution factor may be applied to a specific live load truck type for a special function only (such as deflections or moments) as described below. **For LRFD Option:** ***If DF application option is equal to 2 for moment :*** This value represents the moment distribution factor of the strength/service limit in the positive moment area. ***If DF application option is equal to 3 for shear :*** This value represents the shear distribution factor of the strength/service limit state in the positive moment area. ***If DF application option is equal to 4 for deflection:*** Usually average deflection is used for steel bridges. If option 4 is used, average deflection is overridden.	**NONE**	**REAL**	**OPT.**	
	Distribution Factor, Application Option: This data is used to apply the distribution factor for the indicated span to a particular live load type for a specific function (for example, it may be desired to apply the special distribution factor to an HS-20 truck for computing deflection only). Input the integer 1, 2, 3, or 4 under the live load truck type. A zero (0) or blank indicates that the Special distribution factor is not applied to the indicated loading type. These application options are described in detail in TABLE A.1.6 - DEFINITIONS OF DISTRIBUTION FACTOR OPTIONS.	**NONE**	**INT.**	**OPT.**	**T.A.1.6**

4.2.4C Gamma and Beta (WSD or LFD) (Data Type 09012)

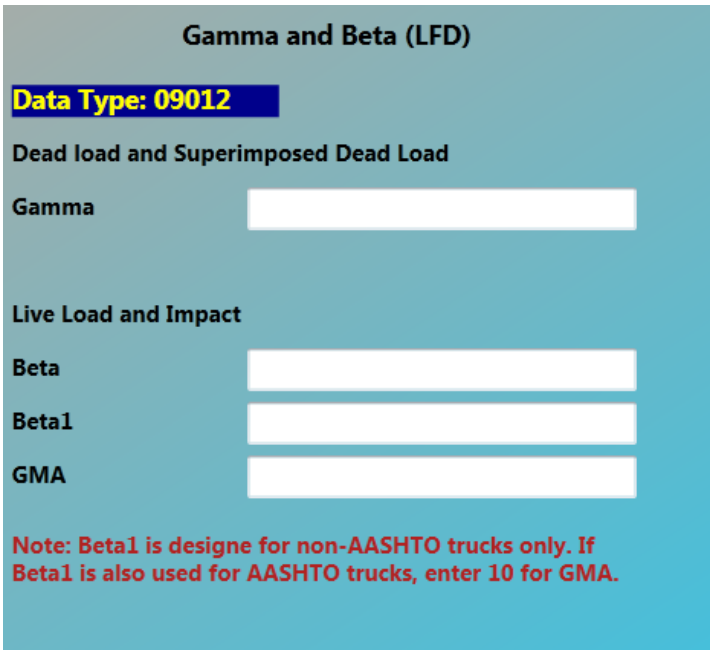

Gamma and Beta (LFD)
Data Type: 09012
Dead load and Superimposed Dead Load
Gamma
Live Load and Impact
Beta
Beta1
GMA
Note: Beta1 is designe for non-AASHTO trucks only. If Beta1 is also used for AASHTO trucks, enter 10 for GMA.

Table 4.17 : Load Factors; Gamma and Beta Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
09012	**For WSD/LFD Option:**				
	Load Factor Gamma: Factor for Dead Load. **Default = 1.3**.	**NONE**	**REAL**	**OPT.**	
	Load Factor Beta: Factor for Live Load. **Default = 5/3.**	**NONE**	**REAL**	**OPT.**	
	Load Factor Beta 1: Factor for Overload Live Load. **Default = 5/3.**	**NONE**	**REAL**	**OPT.**	
	Penn DOT Load Factor Gamma: Gamma is a factor for Penn DOT formula. If 0 or blank, Penn DOT table will not show up. GMA = 1.3 for staggered cross frames = 1.0 for non-staggered Note: Beta1 is designed for Non-AASHTO trucks only. If Beta1 is also used for AASHTO trucks input GMA = 10	**NONE**	**REAL**	**OPT.**	

4.2.4D Load and Resistance Factors (LRFD) (Data Type 09012)

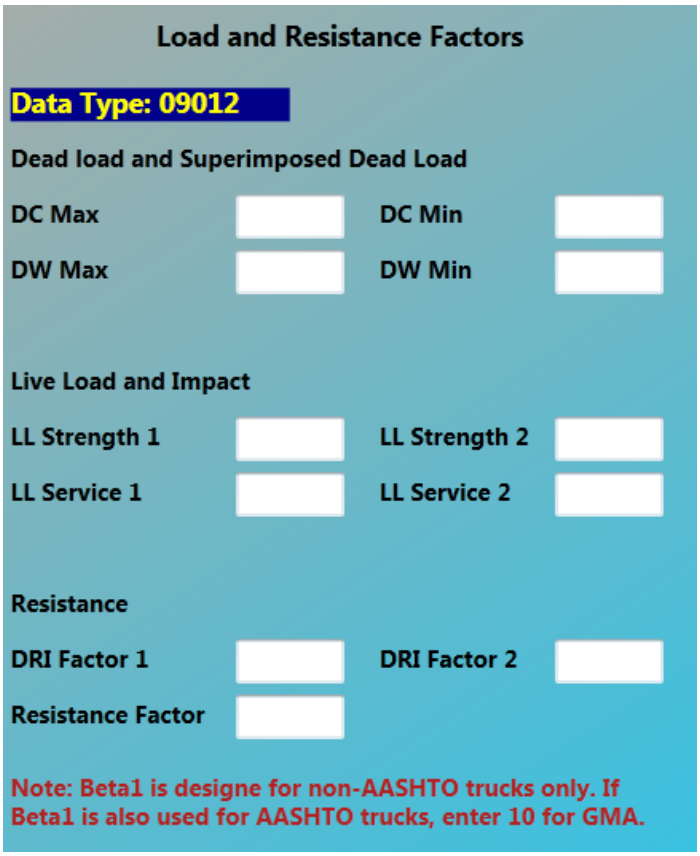


Table 4.18 : Load Factors; LRFD Option

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
09012	**For LRFD Option:**				
	Load Factor for DC Maximum: Maximum load factor for component and attachments. **Default = 1.25**	NONE	REAL	OPT.	
	Load Factor for DC Minimum: Minimum load factor for component and attachments. **Default = 0.90**	NONE	REAL	OPT.	
	Load Factor for DW Maximum: Maximum load factor for wearing surfaces and utilities. **Default = 1.50**	NONE	REAL	OPT.	

Table 4.18 : Load Factors; LRFD Option

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
09012 ***(cont.)***	***Load Factor for DW Minimum:*** Minimum load factor for wearing surfaces and utilities. **Default = 0.65**	**NONE**	**REAL**	**OPT.**	
	Load Factor for Strength-I Live Load: Live load factor for Strength-I load combination relating to the normal vehicles. **Default = 1.75**	**NONE**	**REAL**	**OPT.**	
	Load Factor for Strength-II Live Load: Live load factor for Strength-II load combination relating to the special design vehicles and/or permit vehicles. **Default = 1.35**	**NONE**	**REAL**	**OPT.**	
	Load Factor for Service-I Live Load: Live load factor for Service-I load combination relating to the normal operational use of the bridge **Default = 1.00**	**NONE**	**REAL**	**OPT.**	
	Load Factor for Service-II Live Load: Live load factor for Service-II load combination relating to yielding and slip control. **Default = 1.30**	**NONE**	**REAL**	**OPT.**	
	Load Factor for Fatigue Live Load: Live load factor for Fatigue Load combination under a single design truck. **Default = 0.75**	**NONE**	**REAL**	**OPT.**	
	Load Modifier DRI Factor 1 for Strength Limit State: A combined factor relating to ductility, redundancy, and operational importance for strength limit state. **Default = 1.00**	**NONE**	**REAL**	**OPT.**	
	Load Modifier DRI Factor 2 for all other Limit States: A combined factor relating to ductility, redundancy, and operational importance for all other limit states. **Default = 1.00**	**NONE**	**REAL**	**OPT.**	

Table 4.18 : Load Factors; LRFD Option

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
09012 **(cont.)**	***Resistance Factor:*** $\Phi_R = \Phi_c\Phi_s\Phi$ where Φ_c = condition factor, Φ_s = system factor and Φ = LRFD resistance factor. **Default = 1.00**	**NONE**	**REAL**	**OPT.**	

4.2.5 Live Load

Live Load group contains AASHTO Live Loading - Load Type A (Data Type 06012),State Vehicle Loading - Load Types D and M (Data Type 06022),General Vehicle Loading - Load Type G (Data Type 06032) and Special Vehicle Loading - Load Type C (Data Type 07012)

4.2.5A AASHTO Live Load (Data Type 06012)

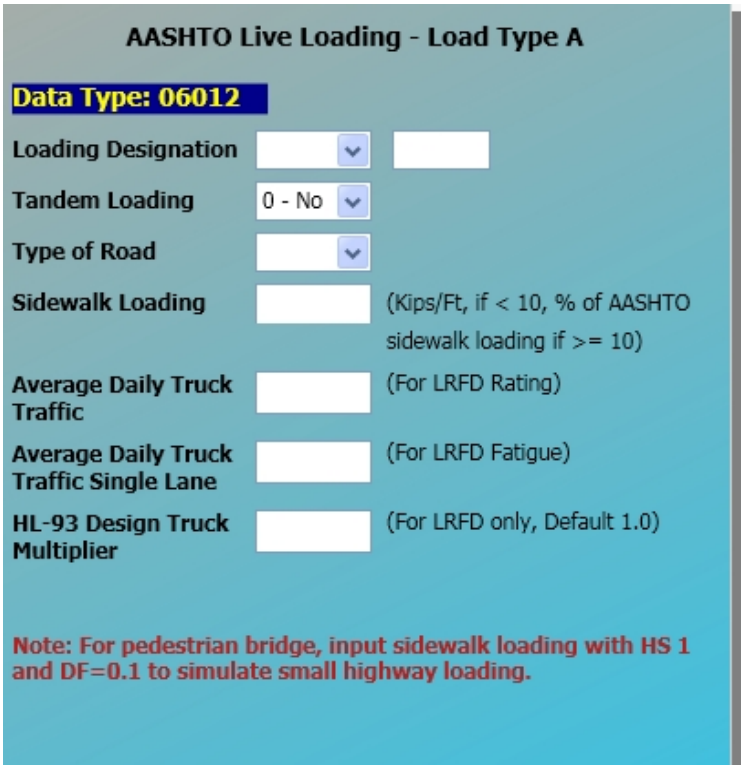

AASHTO Live Loading - Load Type A
Data Type: 06012
Loading Designation
Tandem Loading
0 - No
Type of Road
Sidewalk Loading
(Kips/Ft, if < 10, % of AASHTO sidewalk loading if >= 10)
Average Daily Truck Traffic
(For LRFD Rating)
Average Daily Truck Traffic Single Lane
(For LRFD Fatigue)
HL-93 Design Truck Multiplier
(For LRFD only, Default 1.0)
Note: For pedestrian bridge, input sidewalk loading with HS 1 and DF=0.1 to simulate small highway loading.

Table 4.19 : AASHTO Live Load Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
06012	**AASHTO Live Loading - Loading Type A**				
	H, HS and HL Loading Designation: AASHTO loading designation from H-15, H-20, HS-15, HS-20, and up to HS-99 (H, HS, HL must be upper case letters) **NOTE :** For SI units, M or MS is used in stead of H or HS. For example, MS 18 is equivalent to HS 20. For LRFD design option, HL 93 is the design truck.	**NONE**	**ALPHA**	**OPT.**	**REF.1 T.A.1.4**
	Tandem Loading : 0 = No (Default) 1 = Yes 2 = Yes; weight is proportional to HS loading over HS20	**NONE**	**INT.**	**OPT.**	**REF.1**
	Type of Road Case 1, 2, 3 (WSD/LFD) 1 = Case I (Default), 2 = Case II, 3 = Case III As defined by AASHTO (See the AASHTO Specifications "TABLE 10.3.2A Stress Cycles"). ***Case 1, 2, 3, 4 (LRFD)*** Table (C3.6.1.4.2-1) 1 = Rural Interstate, 2 = Urban Interstate 3 = Other Rural, 4 = Other Urban (Fraction of truck in traffic = 0.20, 0.15, 0.15, 0.10 respectively)	**NONE**	**INT.**	**OPT.**	**REF.1**
	Sidewalk Loading per beam: Sidewalk live load intensity. (K/Ft or KN/m if < 10) (% of AASHTO sidewalk loading if >= 10)	**kips/ft (kN/m)**	**REAL**	**OPT.**	**REF.1**
	Average Daily Truck Traffic (for LRFD Fatigue) ADTT for the LRFD fatigue calculation. Default is 20,000vehicles per lane per day (ADT) times the fraction of truck traffic based on class of highway (road type) defined in LRFD Table C3.6.1.4.2-1. This entry is the ADTT, not ADTTSL. ADTTSL is equal to ADTT * pp where pp = 1 if one lane only, = 0.85 if two lanes, = 0.8 if more than two can fit within the width between curbs. Please note that ADTTSL is used in fatigue and ADTT itself is used in LRFD rating.	**NONE**	**INT.**	**OPT.**	
	HL-93 Design Truck Multiplier (for LRFD only) (default = 1.0)	**NONE**	**REAL**	**OPT.**	

4.2.5B State Vehicle Loading (Data Type 06022)

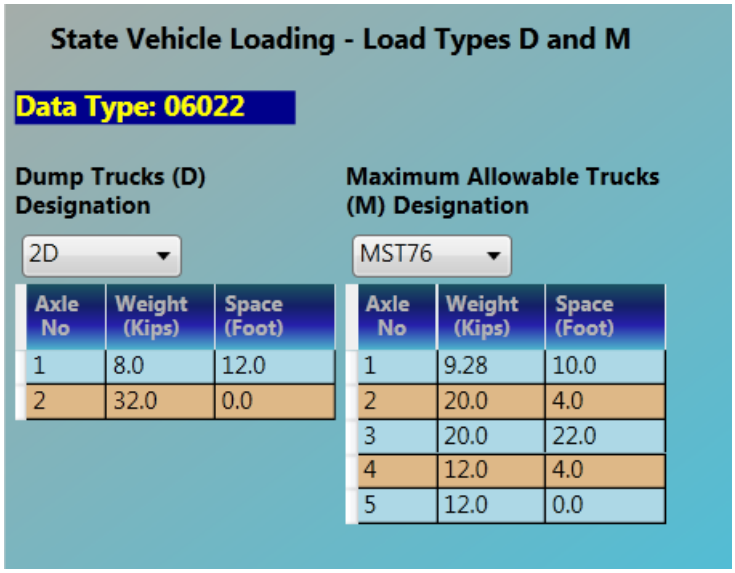


Table 4.20 : State Vehicle Loading Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
06022	**State Loading - Loading Type D & M**				
	D Loading Designation: Dump truck loading designation is either 2D or 3D or any predefined vehicle with no more than 3 axles (Loading Designation is limited to 2 characters).	**NONE**	**ALPHA**	**OPT.**	**REF.1 T.A1.4**
	M Loading Designation: Maximum allowable truck loading designation can be 3, 3S2, 3-3, or MST76, or any predefined vehicle with no more than 6 axles (Loading Designation is limited to 6 characters).	**NONE**	**ALPHA**	**OPT.**	**REF.1 T.A.1.4**

4.2.5C General Vehicles (Data Type 06032)

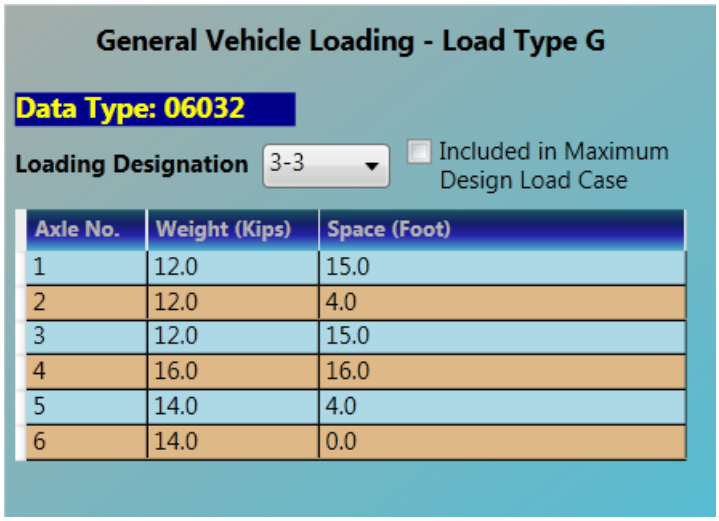


Table 4.21: General Vehicles Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
06032	**General Vehicles - Loading Type G** ***G Loading Designation:*** Input any 4 characters for general vehicles or any predefined vehicle with no more than 20 axles. ***Design Load:*** Blank = No 1 = Yes. This loading will be considered in the Maximum Design Load Case. (For Steel only) If the Design Load is 1, the maximum load effect is the maximum of the AASHTO vehicle and the Load Type G. If the Design Load is Blank, the maximum load effect is considering AASHTO vehicle and the Load Type G side by side.	**NONE**	**INT.**	**OPT.**	

Note for LRFD Results: (For Steel only)
1. Values for Service 1, Strength I, Strength IV, and Fatigue limit states are based on the AASHTO vehicles only.
2. Strength II limit state is due to side-by-side AASHTO and General vehicles.
3. Service II limit state is based on the maximum of the AASHTO or the General vehicles.

4.2.5D Special Vehicle Loading – Load Type C (Data Type 07012)

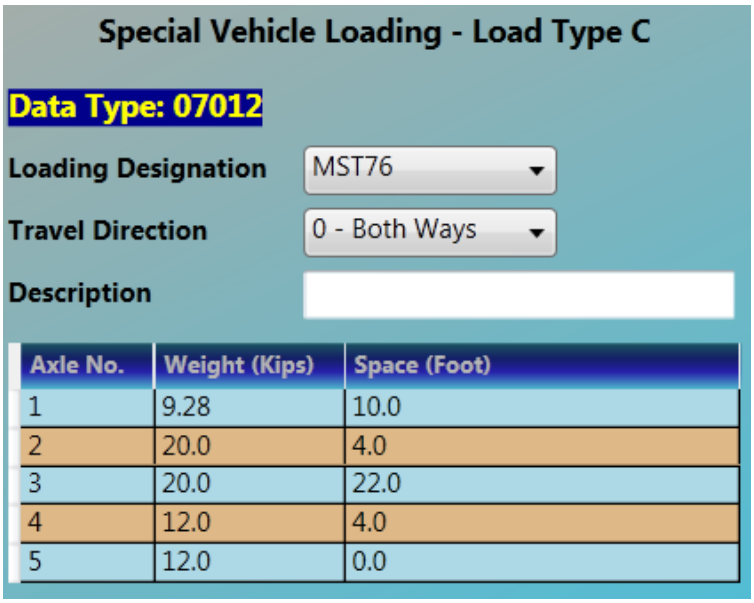


Table 4.22 : Special Vehicle ID and Description Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
07012	**Special Vehicle Identification and Description - Load Type C**				
	Loading Designation: Designation which identifies vehicle (Arbitrary as defined by the user).	**NONE**	**ALPHA**	**OPT.**	**T.A.1.4**
	Direction of Travel: Input option to define direction of travel. This option is usually used to evaluate the passage of special permit vehicles. 0 = Both Ways **(Default)** 1 = Left to Right 2 = Right to Left	**NONE**	**INT.**	**OPT.**	
	Description: Description of vehicle.	**NONE**	**ALPHA**	**OPT.**	

4.2.6 Dead Load

Dead Load group contains Slab Loads Per Beam (Data Type 10012),Arbitrary Uniform and Concentrated Loads Per Beam (Data Type 11012) and Auto Generation of Dead and Superimposed Dead Loads (Data Type 02012). For steel bridges this group also contains Lateral Bending Stress Loads (Data Type 11022).

4.2.6A Slab Loads (per beam) (Data Type 10012)

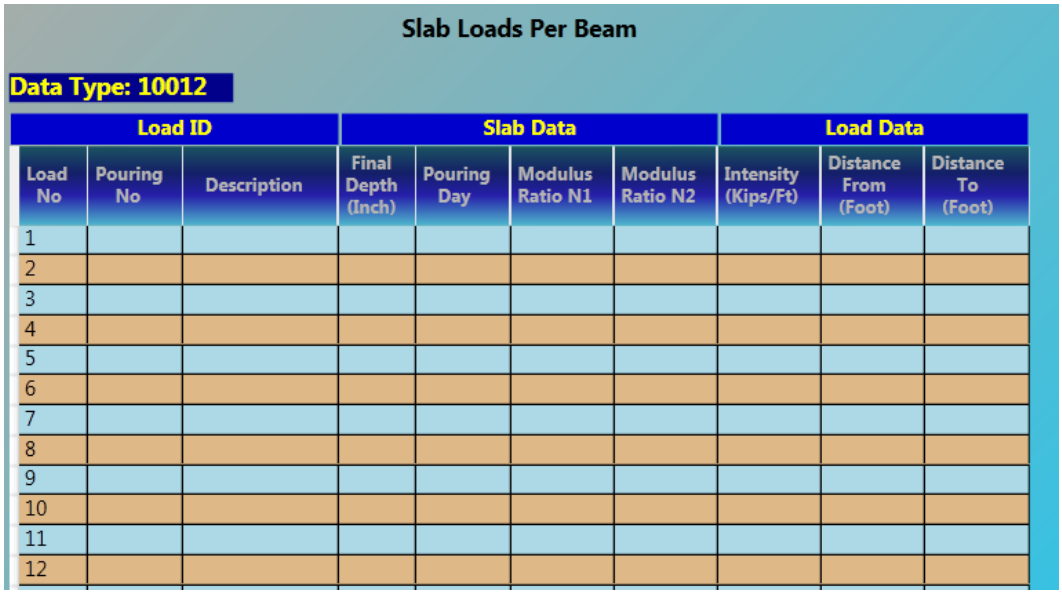


Table 4.23 : Slab Loads Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
10012	**Slab Loads:** A constant uniformly distributed load acting over the entire bridge and must be defined per span if more than one span exists.				
	Load Identification Number: The sequence number of the load. The loads for staging as well as non-staged slab loads must be numbered sequentially beginning with one (1).	**NONE**	**INT.**	**REQ.**	
	Pouring Number : Starting from one (1).				
	Load Identification Description: Any identification for the particular LOAD and SEQUENCE identified.	**NONE**	**ALPHA**	**OPT.**	

(continued)

Table 4.23 : Slab Loads Input Description *(continued)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
10012 ***(cont.)***	***Slab Data, Final Design Depth:*** Depth of the slab at the point of maximum wear. This is used to calculate should strength and therefore be the minimum value design depth. (excluding integral wearing surface depth)	**in (mm)**	**REAL**	**REQ.**	
	Pouring Day: Pouring day counted from the first pour. Therefore, the first pour is always zero (0) day.				
	Slab Data, Final Modular Ratios N1 and N2: These values are the modular ratios (Es/Ec) used in computing the composite section properties under superimposed dead and live load conditions. The default values for N1 and N2 are 24 and 8 respectively.	**NONE**	**REAL**	**REQ.**	
	Load Data, Load Intensity: Intensity of the uniform slab load identified by load number and sequence number. (including integral wearing surface intensity)	**kips/ft (kN/m)**	**REAL**	**REQ.**	
	Load Position, Distance From/Distance To: Location of the left and right ends of the uniform slab load measured from the extreme left support of the bridge.	**ft (m)**	**REAL**	**REQ.**	

4.2.6B Arbitrary Uniform and Concentrated Loads (per beam) (Data Type 11012)

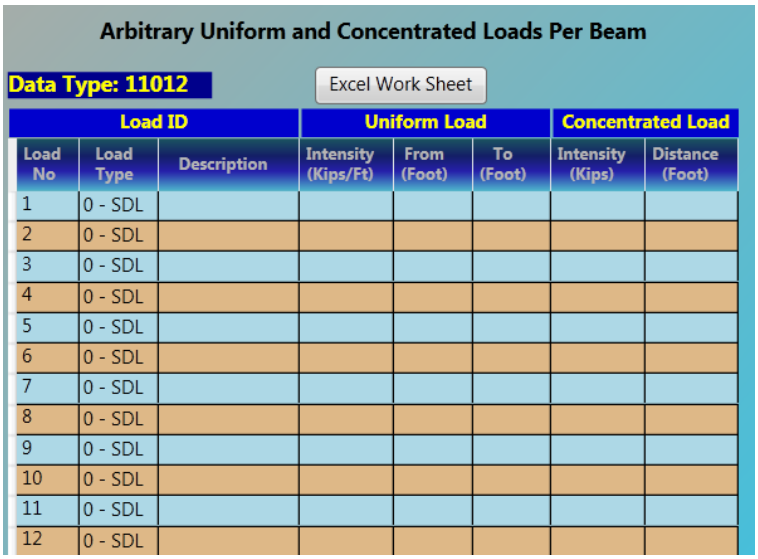


Table 4.24 : Arbitrary Uniform and Concentrated Loads Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
11012	***Load Identification, Load Number:*** Integer beginning with one (1) and proceeding sequentially to the last (nth) load. This data is used to define the sequence of the application of the uniform and concentrated loads.	**NONE**	**INT.**	**REQ.**	
	Load Type: The load types are defined as follows: 0 = Loads for Non-Composite Construction or Superimposed Loads for Composite Construction (DW for LRFD) **(Default for Non-Comp. Construction)** 1 = Superimposed Loads (DC2 for LRFD) **(Default for Composite Construction)** 2 = Non-Composite Loads (DC1 for LRFD) For WSD/LFD and non-composite construction, the load type should be either blank or 0; blank, 0, or 1 load types are all superimposed loads. For LRFD, please follow the above defined load type.	**NONE**	**INT.**	**OPT.**	
	Load Identification, Description: ALPHANUMERIC description identifying the LOAD NUMBER.	**NONE**	**ALPHA**	**OPT.**	
	Uniform Load Data, Intensity: Intensity of the uniform load identified by LOAD NUMBER and SEQUENCE NUMBER.	**kips/ft (kN/m)**	**REAL**	**OPT.**	
	Uniform Load Position, Distance From/Distance To: Location of the left and right ends of the uniform load measured from the extreme left support of the bridge, respectively. Leave blank if identifying a uniform load applied throughout the entire bridge.	**ft (m)**	**REAL**	**OPT.**	
	Concentrated Load Data, Intensity: Intensity of the concentrated load identified by LOAD NUMBER and SEQUENCE NUMBER. Leave blank if identifying a uniform load.	**kips (kN)**	**REAL**	**OPT.**	
	Concentrated Load Data/Distance To: Location of the concentrated load as measured from the extreme left support of the bridge.	**ft (m)**	**REAL**	**OPT.**	

4.2.6C Lateral Bending Stress Load (per beam) (Data Type 11022)

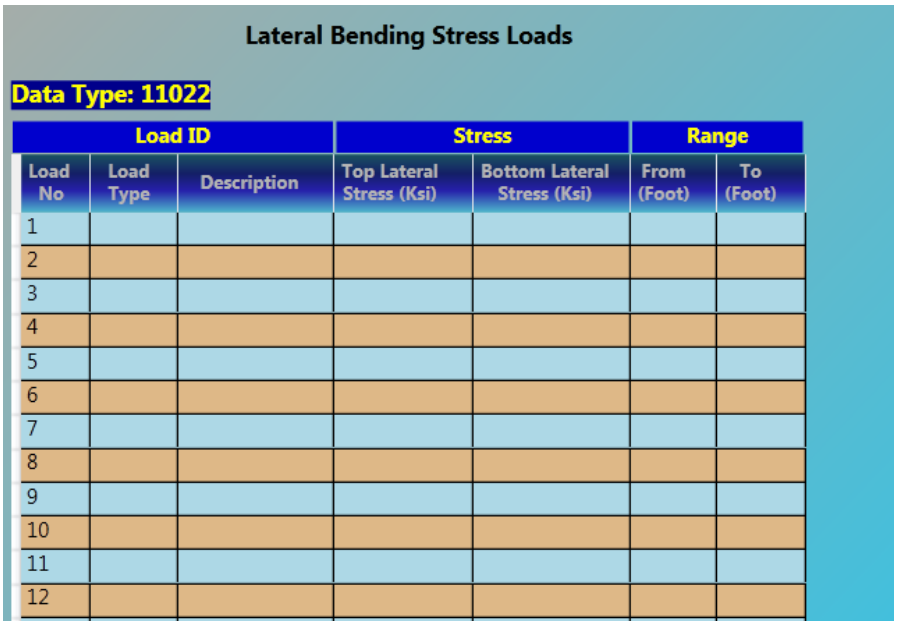


Table 4.25 : Lateral Bending Stress Load Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
11022	***Load Identification, Load Number:*** Integer beginning with one (1) and proceeding sequentially to the last (nth) load. This data is used to define the sequence of the application of the uniform and concentrated loads.	**NONE**	**INT.**	**REQ.**	
	Load Type: The load types are defined as follows: 1 - Construction limit state 2 - Strength limit state 3 - Both	**NONE**	**INT.**	**OPT.**	
	Load Identification, Description: ALPHANUMERIC description identifying the LOAD NUMBER.	**NONE**	**ALPHA**	**OPT.**	
	Top Lateral Stress/ Bottom Lateral Stress: Input (amplified) positive factored values and the program will maximize the total stresses in Tables 1.2.22.10 and 1.2.22.14.	**Ksi (Mpa)**	**REAL**	**OPT.**	
	Distance From/Distance To: Location of the left and right ends of the lateral stress measured from the extreme left support of the bridge, respectively.	**Ft (m)**	**REAL**	**OPT.**	

4.2.6D Auto Generation of Dead and Superimposed Dead Loads (Data Type 02012)

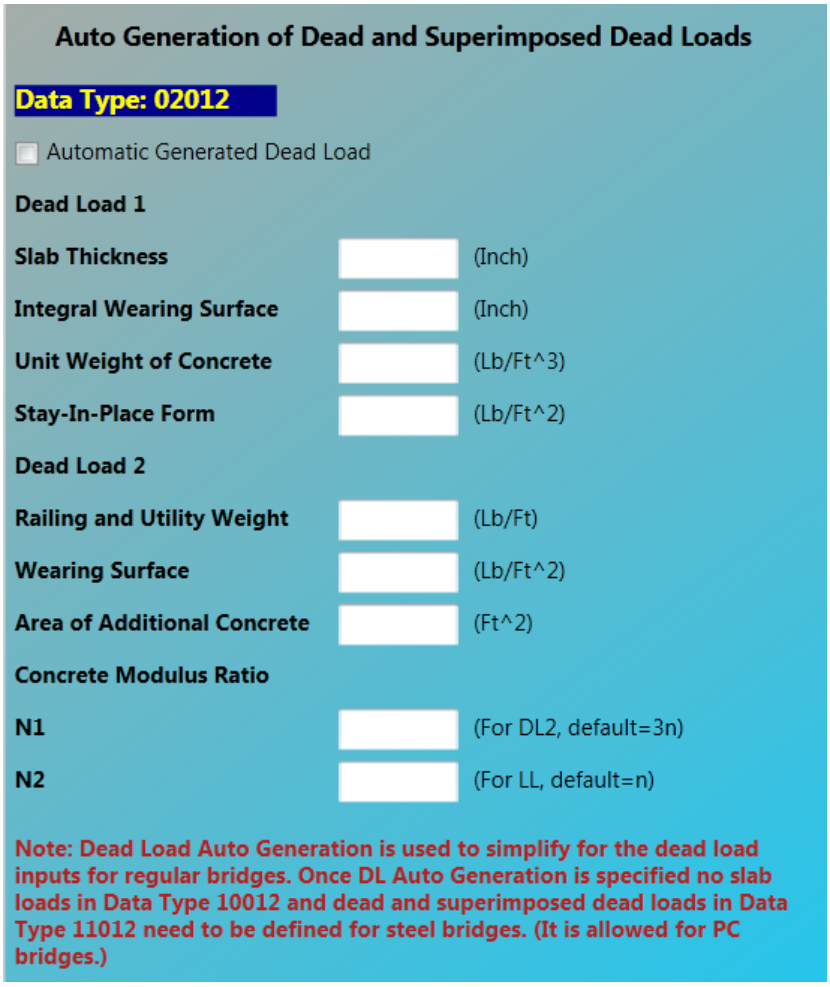

Auto Generation of Dead and Superimposed Dead Loads
Data Type: 02012
Automatic Generated Dead Load
Dead Load 1
Slab Thickness
(Inch)
Integral Wearing Surface
(Inch)
Unit Weight of Concrete
(Lb/Ft^3)
Stay-In-Place Form
(Lb/Ft^2)
Dead Load 2
Railing and Utility Weight
(Lb/Ft)
Wearing Surface
(Lb/Ft^2)
Area of Additional Concrete
(Ft^2)
Concrete Modulus Ratio
N1
(For DL2, default=3n)
N2
(For LL, default=n)
Note: Dead Load Auto Generation is used to simplify for the dead load inputs for regular bridges. Once DL Auto Generation is specified no slab loads in Data Type 10012 and dead and superimposed dead loads in Data Type 11012 need to be defined for steel bridges. (It is allowed for PC bridges.)

Table 4.26: Auto Generation of Dead Loads

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
02012	**Auto Generation of DL1 and DL2**				
	Option for the auto generation:	**NONE**	**INT.**	**OPT.**	
	0 or blank (default): DL1 and DL2 will not be generated automatically and should be input manually in Data Types 10012 and 11012. 1: Auto Generation of DL1 and DL2 is based on the input on this screen.				
	Dead Load 1 (per bridge)				
	Thickness of Slab: Constant slab thickness (excluding integral wearing surface) throughout. If there is any change in the thickness, Data Type 10012 should be used. This is also used to calculate strength.	**in (mm)**	**REAL**	**OPT.**	
	Thickness of the Integral Wearing Surface: Integral wearing surface will be counted for DL1 but not the section property calculation. This is used for load intensity only.	**in (mm)**	**REAL**	**OPT.**	
	Unit Weight of Concrete: Used to calculate DL1 based on thicknesses of slab and integral wearing surface and haunch, and DL2 for any additional concrete.	**lb/ft^3 (kg/m^3)**	**REAL**	**OPT.**	
	Stay-in-place form: for DL1, weight intensity of stay-in-place form to be distributed to all girders/beams	**lb/ft^2 (Kg/m^2)**	**REAL**	**OPT.**	
	Dead Load 2 (per bridge)				
	Railing/Utility Weight: for DL2, it is total weight of both railing and utility, will be shared equally by all girders/beams.	**lb/ft (N/m)**	**REAL**	**OPT.**	
	Wearing surface: for DL2, the weight intensity will be shared equally by all girders/beams.	**lb/ft^2 (kg/m^2)**	**REAL**	**OPT.**	
	Area of Additional Concrete: for DL2, will be shared equally by all girders/beams.	**Ft^2 (m^2)**	**REAL**	**OPT.**	
	Concrete Modulus Ratio: Values are the modular ratios (Es/Ec) used in computing the composite section properties under superimposed dead and live load conditions. N1 (for DL2, default = 3N = 24) N2 (for LL, default = N = 8)	**NONE**	**REAL**	**OPT.**	

4.2.7 **Design** (Used for Flow Control = 4 or 6 only)

Design group contains Splice Design (Data Type 12012), Design Method and Stiffener Option (Data Type 12042), Designate Plate Size (Data Type 12052), Design Plate Size Range (Data Type 12062),Material and Fabrication Cost (Data Type 12072) and Field Splice Location and Material ID (Data Type 12082). All data types in this group are for steel bridges only.

4.2.7A Splice Design Data (Data Type 12012)

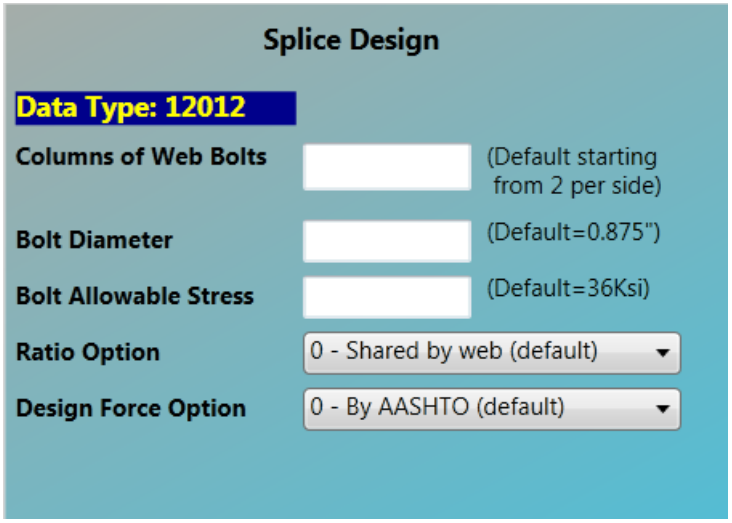


Table 4.27 : Splice Design Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12012	***Number of Columns of Web Bolts :*** **Default** will start from 2. No more than 5 columns per side are allowed.	**NONE**	**INT.**	**OPT.**	
	Bolt Diameter : **Default** is 0.875 in. (22 mm for SI units)	**In (mm)**	**REAL**	**OPT.**	
	Bolt Allowable Stress : **Default** is 15 Ksi (103 MPa) for WSD, 35 Ksi (241 MPa) for LFD/LRFD**.** **NOTE :** Please refer to AASHTO Specification Table 10.32.3C for WSD (p. 253), Table 10.56A for LFD (p. 293).	**Ksi (MPa)**	**REAL**	**OPT.**	

4.2.7B Design Method and Stiffener Option (Data Type 12042)

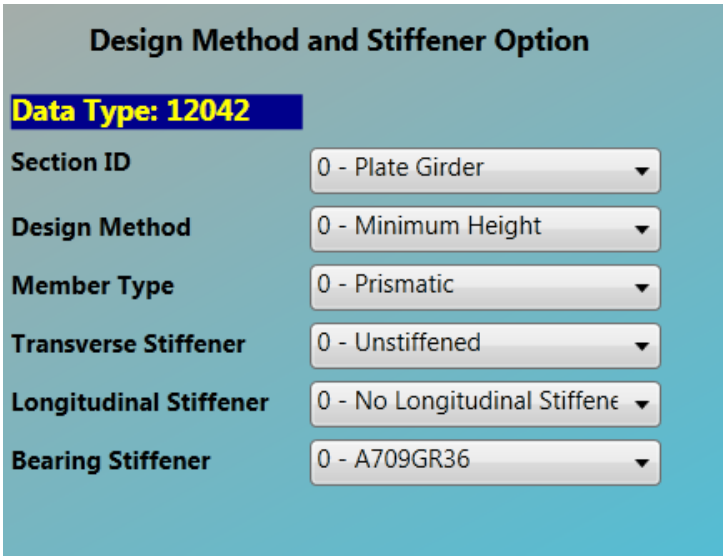


Table 4.28: Design Method and Stiffener Option Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12042	***Section ID*** 0 = Plate girder 1 = Wide flange (compact) 2 = Wide flange (braced non-compact)	NONE	INT.	OPT.	
	Design Method : For optimization; 0 = Minimum weight 1 = Minimum cost	NONE	INT.	OPT.	
	Member Type: 0 = Prismatic (Default) 1 = Linear 2 = Parabolic - concave down 3 = Parabolic - concave up	NONE	INT.	OPT.	
	Transverse Stiffener Option: 0 = Unstiffened 1 = Stiffened	NONE	INT.	OPT.	
	Longitudinal Stiffener Option: 0 = No longitudinal stiffener 1 = Longitudinal stiffener is required	NONE	INT.	OPT.	

4.2.7C Design Plate Size (Data Type 12052)

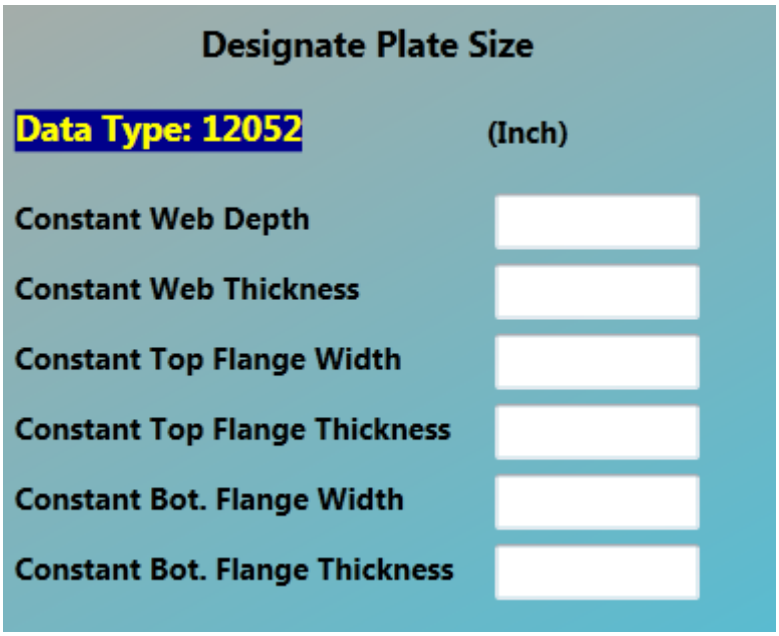


Table 4.29 : Designated Plate Size Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12052	**The following sizes are allowed to be fixed in design:**				
	Web Plate Depth:	**in (mm)**	**REAL**	**OPT.**	
	Web Plate Thickness:	**in (mm)**	**REAL**	**OPT.**	
	Top Flange Width:	**in (mm)**	**REAL**	**OPT.**	
	Top Flange Thickness:	**in (mm)**	**REAL**	**OPT.**	
	Bottom Flange Width:	**in (mm)**	**REAL**	**OPT.**	
	Bottom Flange Thickness:	**in (mm)**	**REAL**	**OPT.**	

4.2.7D Design Plate Size Range (Data Type 12062)

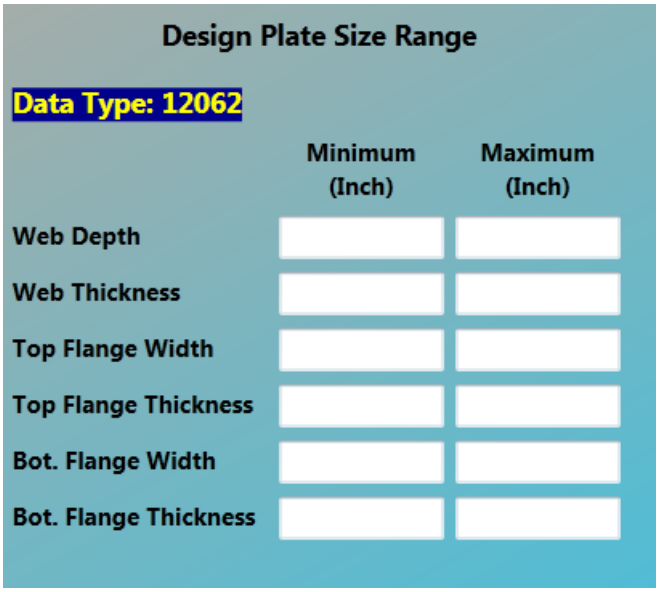


Table 4.30 : Design Plate Size Range Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12062	**The following plate sizes are allowed to be within the ranges of the max. and min.**				
	Web Plate Depth Max:	**in (mm)**	**REAL**	**OPT.**	
	(Used as the depth at pier for nonprismatic design)				
	Web Plate Depth Min:	**in (mm)**	***REAL***	**OPT.**	
	(Used as the depth at mid-span for nonprismatic design)				
	Web Plate Thickness Max:	**in (mm)**	***REAL***	**OPT.**	
	Web Plate Thickness Min:	**in (mm)**	***REAL***	**OPT.**	
	Top Flange Width Max:	**in (mm)**	***REAL***	**OPT.**	
	Top Flange Width Min:	**in (mm)**	***REAL***	**OPT.**	
	Top Flange Thickness Max:	**in (mm)**	***REAL***	**OPT.**	
	Top Flange Thickness Min:	**in (mm)**	***REAL***	**OPT.**	
	Bottom Flange Width Max:	**in (mm)**	***REAL***	**OPT.**	
	Bottom Flange Width Min:	**in (mm)**	***REAL***	**OPT.**	

4.2.7E Material and Fabrication Cost (Data Type 12072)

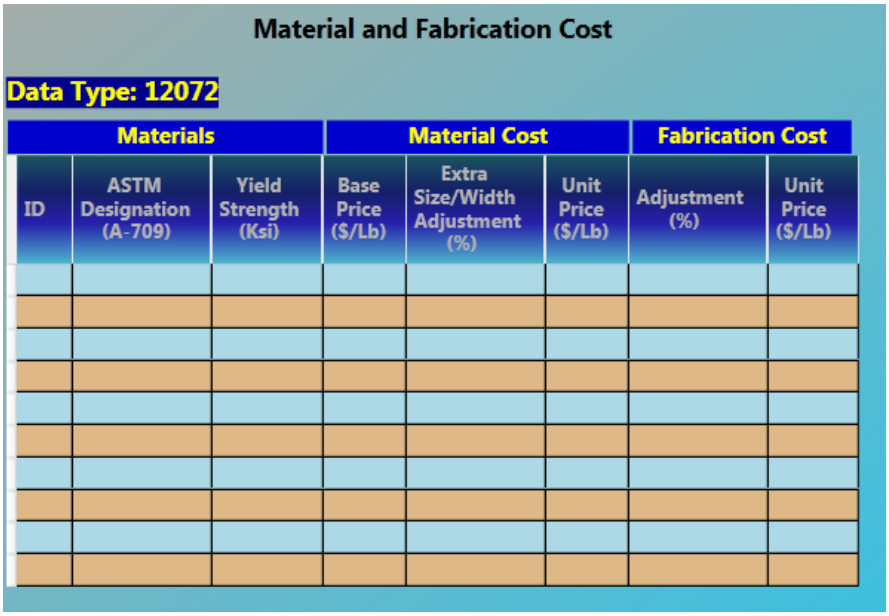


Table 4.31 : Material and Fabrication Cost Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12072	***Material Data, ID:*** Maximum number of materials allowed is three.	**NONE**	**INT.**	**OPT.**	
	Material Data ASTM Designation/Yield Strength/Weathering: Designation always will be A-709 with yield strength 36, 50, 70, 100, no weathering or weathering. (Default is 36 ksi yield strength for design)	**NONE**	**ALPHA**	**OPT.**	
	Material Cost, Base Price: Override base price used in the cost function.	**$/lb** **$/kg**	**REAL**	**OPT.**	
	Material Cost, Extras Adjustment: Override extras adjustment used in the cost function.	**%** **$/kg**	**REAL**	**OPT.**	
	Material Cost: Override base price and extras.	**$/lb**	**REAL**	**OPT.**	
	Fabrication Cost, Adjustment : Override fabrication cost used in the cost function**.**	**%**	**REAL**	**OPT.**	
	Fabrication Cost, Unit Price : Override fabrication adjustment used in the cost function.	**$/lb** **$/kg**	**REAL**	**OPT.**	

4.2.7F Field Splice Location and Material ID (Data Type 12082)

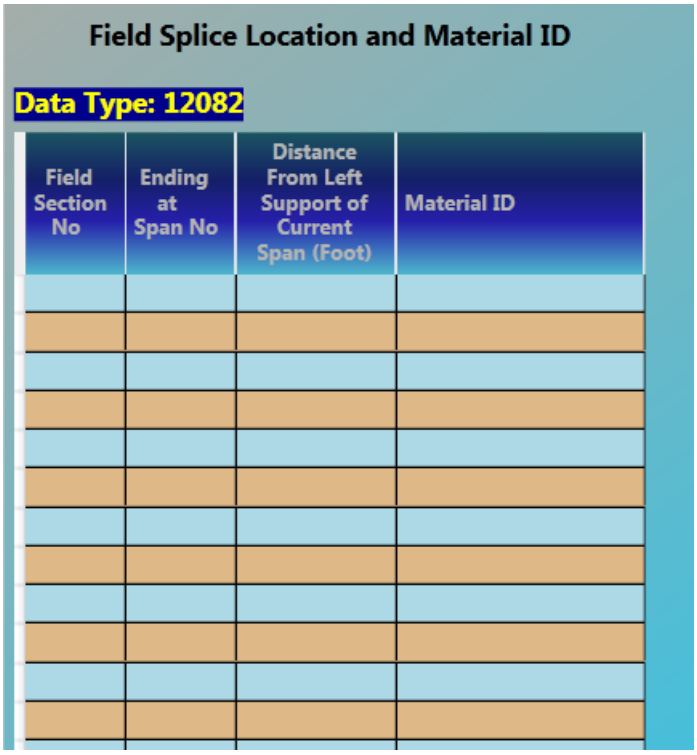

Field Splice Location and Material ID
Data Type: 12082
Field Section No
Ending at Span No
Distance From Left Support of Current Span (Foot)
Material ID

Table 4.32 : Field Splice Location and Material ID Input Description

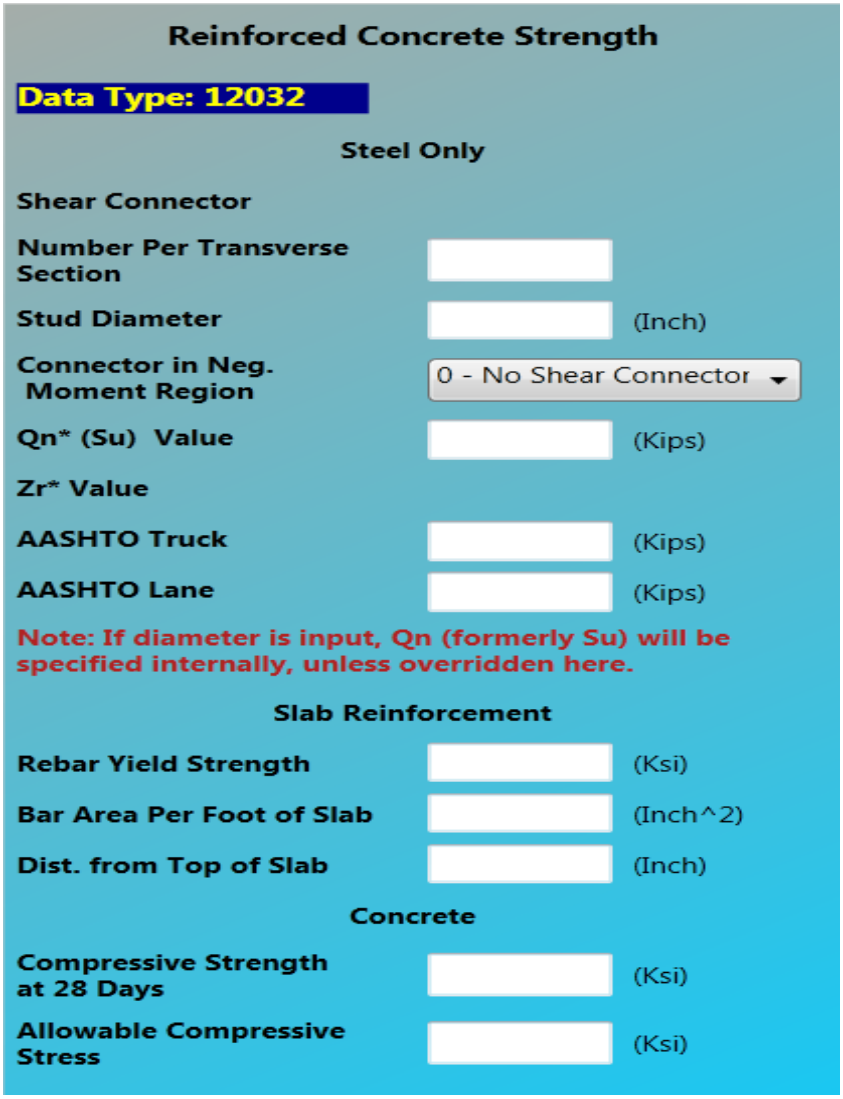
DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12082	***Field Section Number :*** Start from 1, up to 20.	**NONE**	**INT.**	**OPT.**	
	Distance from Left Support of the Current Span : Distance to the end of current section. **NOTE :** The last distance should match the end of the bridge.	**Ft (m)**	**REAL**	**OPT.**	
	Corresponding Material ID : Material ID of the current field section. These material ID numbers correspond to those input on DATA TYPE 12072.	**NONE**	**INT.**	**OPT.**	**DATA TYPE 12072**

4.2.8 Property

4.2.8.1 Steel and Reinforced Concrete

Property group for Steel and Reinforced Concrete bridges contains Reinforced Concrete Strength (Data Type 12032). It is the same for both Steel and Reinforced Concrete bridges.

4.2.8.1A Reinforced Concrete Strength Data (Data Type 12032)



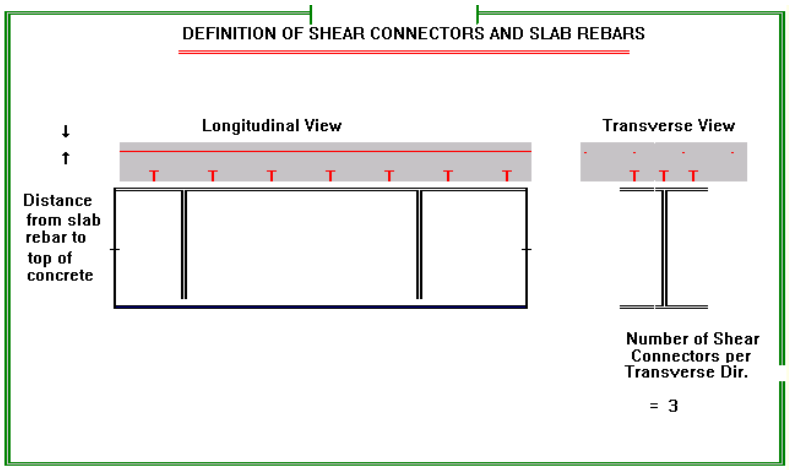

DEFINITION OF SHEAR CONNECTORS AND SLAB REBARS
Longitudinal View
Transverse View
Distance from slab rebar to top of concrete
Number of Shear Connectors per Transverse Dir.
= 3

Table 4.33 : Reinforced Concrete Strength Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12032	***Data, Number Per Transverse Section:*** Number of shear studs per transverse section. If Z section or channel shapes used, input one (1).	**NONE**	**INT.**	**OPT.**	
	Diameter of Studs*: Su value and Zr values for truck and land will be calculated based on the input Road Type (data type 06012) and concrete strength. Default = 7/8 in. (22mm). * With provided stud diameter, program will generate proper Su and Zr values based on AASHTO specs.	**In (mm)**	**REAL**	**OPT**	
	Shear Connector Data, Connectors in Negative Moment Region: Use the following for placement of shear connectors in negative moment region: 0 = No shear connector placed in negative moment regions **(Default)** 1 = Shear connectors placed in negative moment regions	**NONE**	**INT.**	**OPT.**	
	Ultimate Strength of the Shear Connector: Su value defined in Section 10.38.5 of AASHTO for the shear connector ultimate strength requirement.				
	Allowable Range of Horizontal Shear: Zr value for the truck or lane as defined in Section 10.38.5 of AASHTO for the shear connector fatigue requirements. For Road Type 1 (WSD or LFD), enter Zr value for over two million cycles. **Default** =Zr for any Road Type in Data Type 06012 with 7/8 in.(22mm)-Diameter shear studs.				
	INPUT DESCRIPTIONS ABOVE ARE FOR STEEL ONLY				***(cont.)***

Table 4.33: Reinforced Concrete Strength Data Input Description *(cont'd)*

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12032 ***(cont.)***	***Slab Reinforcement Data, Rebar Yield Strength Fy:*** Yield strength of the slab reinforcing bars. This is used in computing section properties in negative moment region.	**Ksi (MPa)**	**REAL**	**OPT.**	
	Slab Reinforcement Data, Bar Area Per Foot (or Meter) of Slab: Area of reinforcing bar per transverse foot (or meter) of slab.	**in^2/ft (mm^2/m)**	**REAL**	**OPT.**	
	Slab Reinforcement Data, Distance From Top of Concrete: Distance from the top of the concrete slab to the center of gravity of the reinforcing bars.	**in (mm)**	**REAL**	**OPT.**	
	Concrete Data, Compressive Strength f'c : **The 28-day** compressive strength of the concrete slab. **Default =** 4000 psi (27.58 MPa).	**Ksi (MPa)**	**REAL**	**OPT.**	
	Concrete Data, Compressive Allowable : **Allowable** compressive strength of the concrete slab.	**Ksi (MPa)**	**REAL**	**OPT.**	

4.2.8.2 Prestressed Concrete

Property group for Prestressed Concrete bridges contains Prestresssing Steel Properties (Data Type 04032),Post-Tensioning Steel Properties (Data Type 04042),Prestressing Concrete Slab (Data Type 12034) and Precast Beam (Data Type 12036).

4.2.8.2A Prestressing Steel Properties (Data Type 04032)

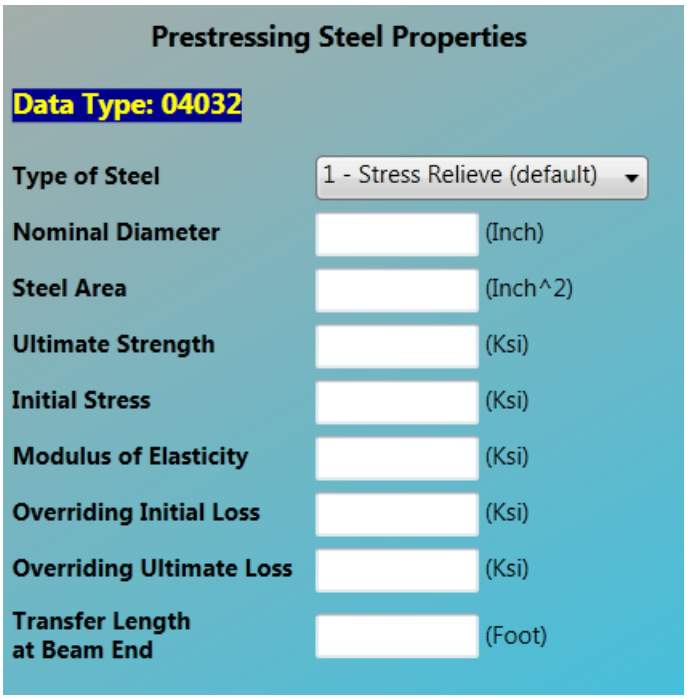


Table 4.34 : Prestressing Steel Properties Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04032	**Type of steel** 1 – stress relieve (default), 2 – low relaxation	NONE	INT.	REQ	
	Nominal Diameter	in. (mm)	REAL	REQ	
	Steel Area	in^2 (mm^2)	REAL	REQ	
	Ultimate Strength	ksi (MPa)	REAL	REQ	
	Initial Stress	ksi (MPa)	REAL	REQ	
	Modulus of Elasticity	ksi (MPa)	REAL	REQ	
	Overriding Initial Loss, which overrides the internally calculated total initial stress loss by AASHTO Code.	ksi (MPa)	REAL	REQ	
	Overriding Ultimate Loss, which overrides the internally calculated total ultimate stress loss by AASHTO Code.	ksi (MPa)	REAL	REQ	
	Transfer Length at Beam End, measured distance from the beam end to the location with full prestressing force (default = 3 ft)	(FT or m)	REAL	REQ	

4.2.8.2B Post-tension Steel Material Properties (Data Type 04042)

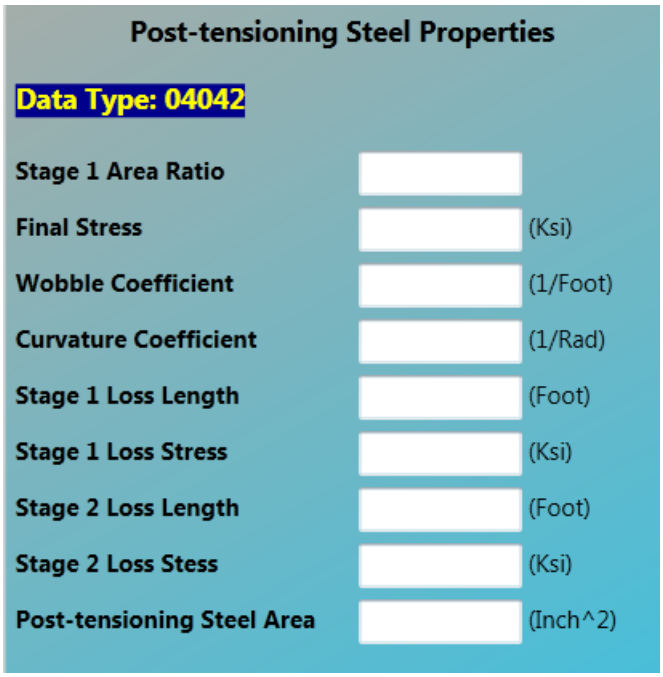


Table 4.35 : Post-tension Steel Material Properties Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
04042	**Stage 1 area ratio:** *Post-tensing steel ratio of ½ stage area to the total area, i.e., if 5 out of 10 post-tensioning steel tendons pull during ½ stage, the ratio is 0.5.*	NONE	INT.	REQ	
	***Final Stress*:** Final stress due to jacking force before loss.	ksi (MPa)	REAL	REQ	
	***Wobble coefficient*:** Wobble friction coefficient.	1/ft (1/m)	REAL	REQ	
	***Curvature coefficient*:** Curvature friction coefficient.	1/rad	REAL	REQ	
	***Stage 1 loss length*:** The length of tendon affected by anchorage set at the end of stage 1.	ft (m)	REAL	REQ	
	***Stage 1 loss stress*:** Stress loss due to anchorage set at the end of stage 1.	ksi (MPa)	REAL	REQ	
	***Stage 2 loss length*:** The length of tendon affected by anchorage set at the end of stage 2.	ft (m)	REAL	REQ	
	***Stage 2 loss stress*:** Stress loss due to anchorage set at the end of stage 2.	ksi (MPa)	REAL	REQ	
	Area of Post-Tensing Steel	in^2 (mm^2)	REAL	REQ	

4.2.8.2C Prestress Concrete Slab (Data Type 12034)

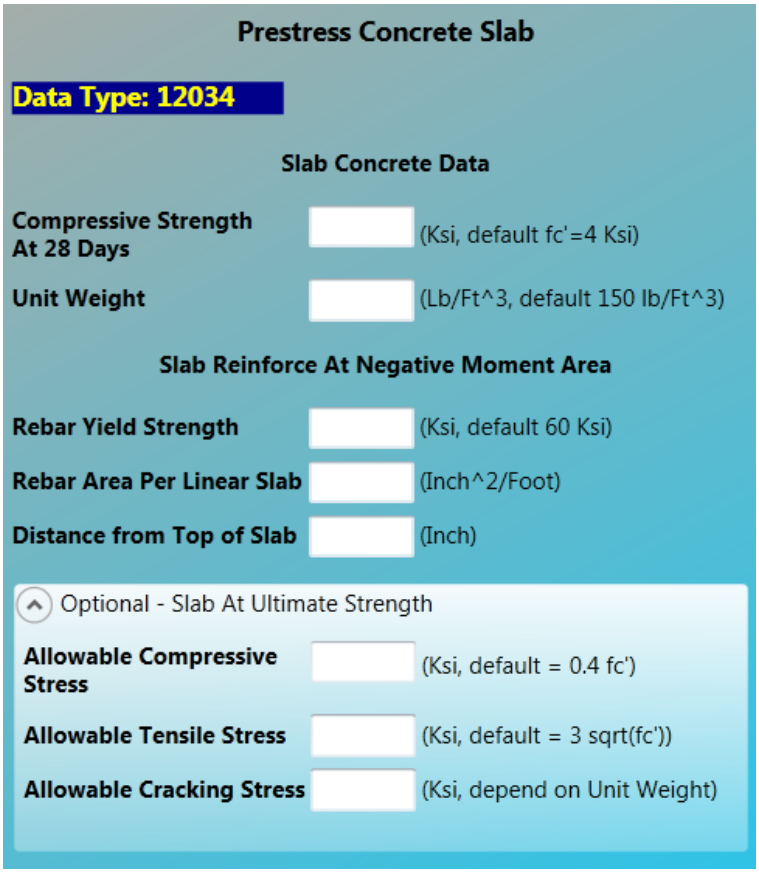


Table 4.36 : Slab Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12034	**Slab Concrete Data**				
	Compressive Strength at 28 days	**ksi (MPa)**	**REAL**	**REQ**	
	Unit weight: used to calculate concrete modulus of Elasticity and weight of slab.	**lb/ft^3 (kg/m^3)**	**REAL**	**REQ**	
	Slab Reinforcement at Negative Moment Area				
	Rebar Yield Strength	**ksi (MPa)**	**REAL**	**REQ**	
	Bar Area/unit width of slab	**in^2/ft (mm^2/m)**	**REAL**	**REQ**	
	Distance from top of slab	**in (mm)**	**REAL**	**REQ**	
	Slab at Ultimate Strength (Optional) (Default = AASHTO allowable)				
	Allowable Compressive Stress	**ksi (MPa)**	**REAL**	**OPT.**	
	Allowable Tensile Stress	**ksi (MPa)**	**REAL**	**OPT.**	
	Allowable Crack Stress	**ksi (MPa)**	**REAL**	**OPT.**	

4.2.8.2D Precast Beam (Data Type 12036)

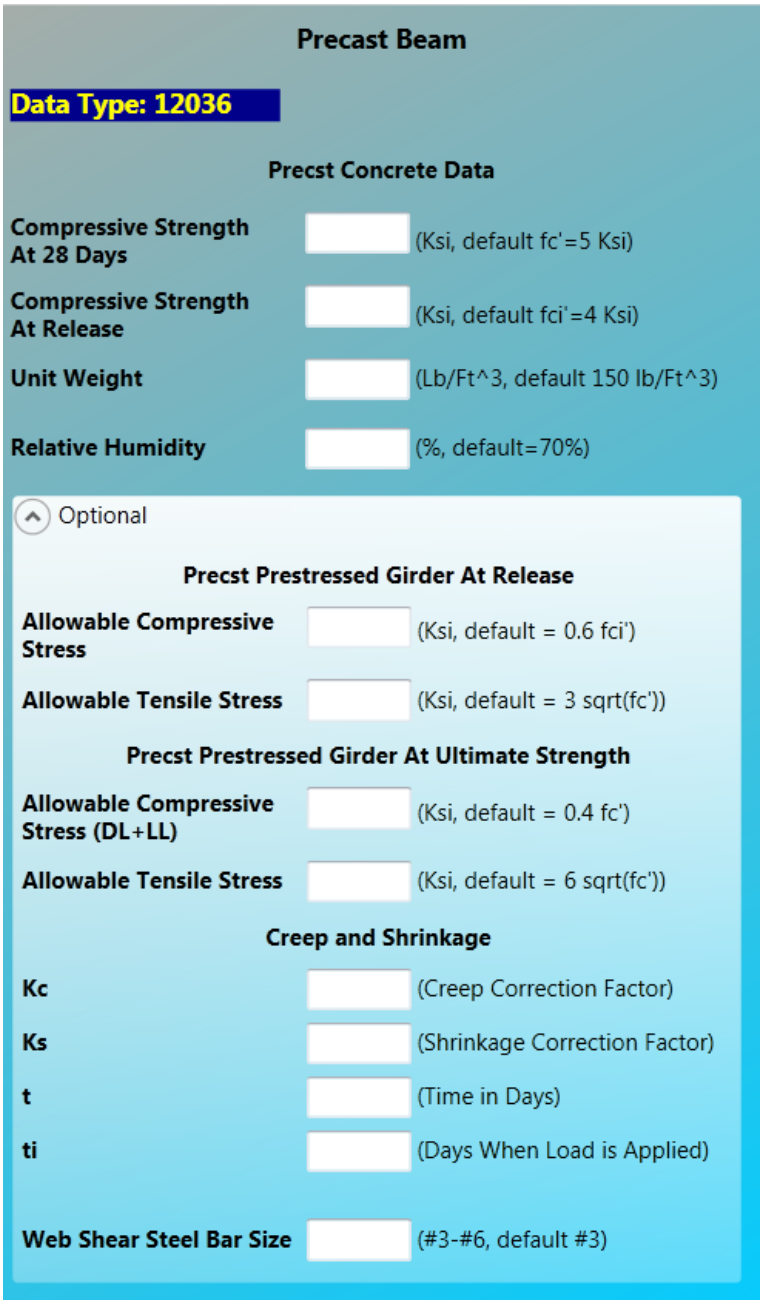


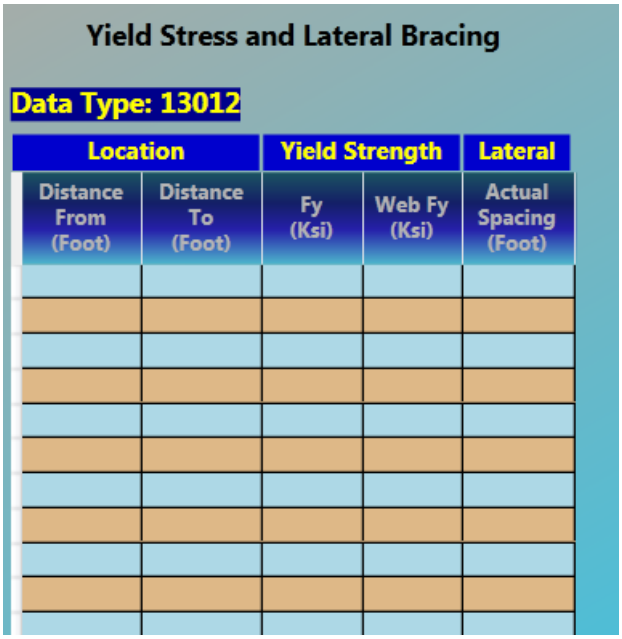
Table 4.37 : Precast Beam Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
12036	**Precast Concrete Data**				
	Compressive Strength at 28 days	**ksi (MPa)**	**Real**	**REQ**	
	Compressive Strength at release	**ksi (MPa)**	**Real**	**REQ**	
	Unit Weight	**lb/ft^3 (kg/m^3)**	**Real**	**REQ**	
	Relation Humidity In Percent For Concrete	**%**	**Real**	**REQ**	
	Precast Prestressed Girder at Release *(Optional)* *(Default = AASHTO allowable)*				
	Allowable Compressive Stress	**ksi (MPa)**	**Real**	**OPT.**	
	Allowable Tensile Stress	**ksi (MPa)**	**Real**	**OPT.**	
	Precast Prestressed Girder at Ultimate Strength *(Optional)* *(Default = AASHTO allowable)*				
	Allowable Compressive Stress	**ksi (MPa)**	**Real**	**OPT.**	
	Allowable Tensile Stress	**ksi (MPa)**	**Real**	**OPT.**	
	Creep and Shrinkage *(Optional)* *(Default = AASHTO allowable)*				
	Kc (Creep Correction Factor)	**NONE**	**Real**	**OPT.**	
	Ks (Shrinkage Correction Factor)	**NONE**	**Real**	**OPT.**	
	t (Time in days)	**Day**	**Real**	**OPT.**	
	ti (Time when load is applied in days)	**Day**	**Real**	**OPT.**	
	Web Shear Steel Bar Size	**NONE**	**Int**	**OPT.**	

4.2.9 Details

Details group contains Yield Stress and Lateral Bracing (Data Type 13012),Longitudinal Stiffener (Data Type 14012) and Transverse Stiffener (Data Type 15012). This group is for steel bridge only.

4.2.9A Girder Field Stress and Lateral Bracing (For Steel bridges only) (Data Type 13012)



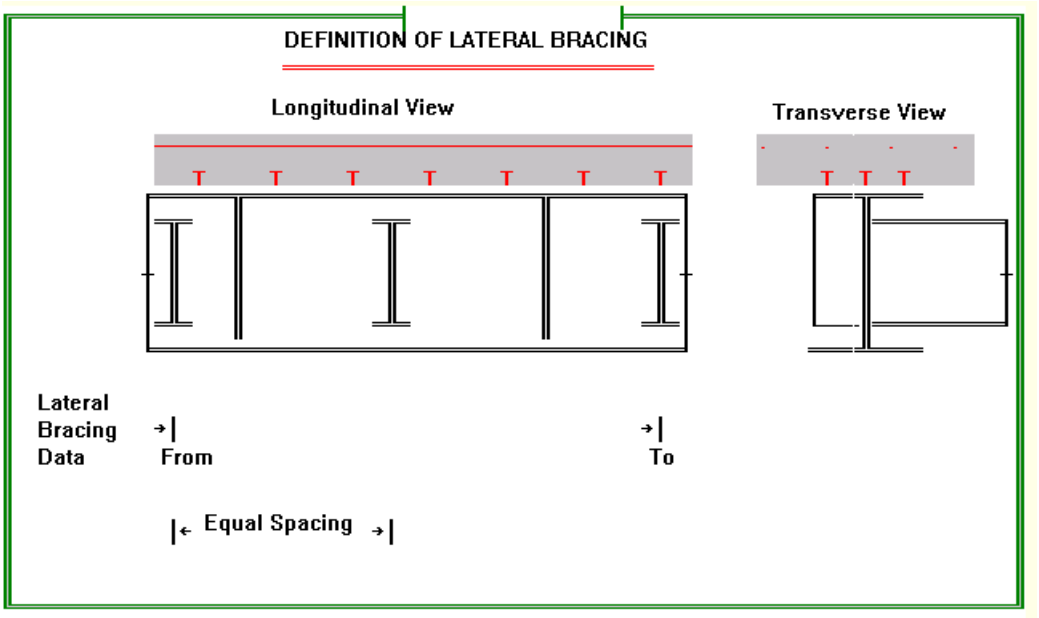


Table 4.38 : Yield Stress and Lateral Bracing Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
13012	***Location, Distance From/To :*** Distance from the left bridge support over which the section or lateral bracing data is given (for a bridge having no change in yield strength, from =0 and to=the total length of the bridge). **NOTE :**The sum of the from/to distance given for section data (required) and bracing data (optional) must equal the entire bridge length. Input of Yield Strength of bracing data where data does not equal to the total bridge length will result in an error and termination of the run (see Table 7.3).	**Ft (m)**	**REAL**	**REQ.**	
	Section Yield Strength, Fy : Yield strength of the material corresponding to the from/to interval (Default = 36 ksi or 248 MPa)	**Ksi (MPa)**	**REAL**	**OPT.**	
	Section Yield Strength (Web) : Yield strength for steel girder. Leave blank if homogeneous or specify if hybrid.	**Ksi (MPa)**	**REAL**	**OPT.**	
	Lateral Bracing Data, Spacing : Lateral bracing spacing within the from/to span interval. This input is used to define the bracing points within the from/to span interval **(Default = equal spacing within span closest to 25 ft or 7.62 m).** **(Default example: Span length=90 ft; So, no. of bracing spacing=90/25=3.6 use 4; Bracing dist. =90/4=22.5 ft)** **Note**: For Mixed or Hybrid Steel, use Data Type 05012-Definition of Members.	**Ft (m)**	**REAL**	**OPT.**	

4.2.9B Longitudinal Stiffener (For Steel bridges only) (Data Type 14012)

Longitudinal Stiffener

Data Type: 14012

Location		Yield	Top Stiffener			Bottom Stiffener		
Distance From (Foot)	Distance To (Foot)	Fy (Ksi)	Location (Inch or fraction)	Width (Inch)	Thickness (Inch)	Location (Inch or fraction)	Width (Inch)	Thickness (Inch)

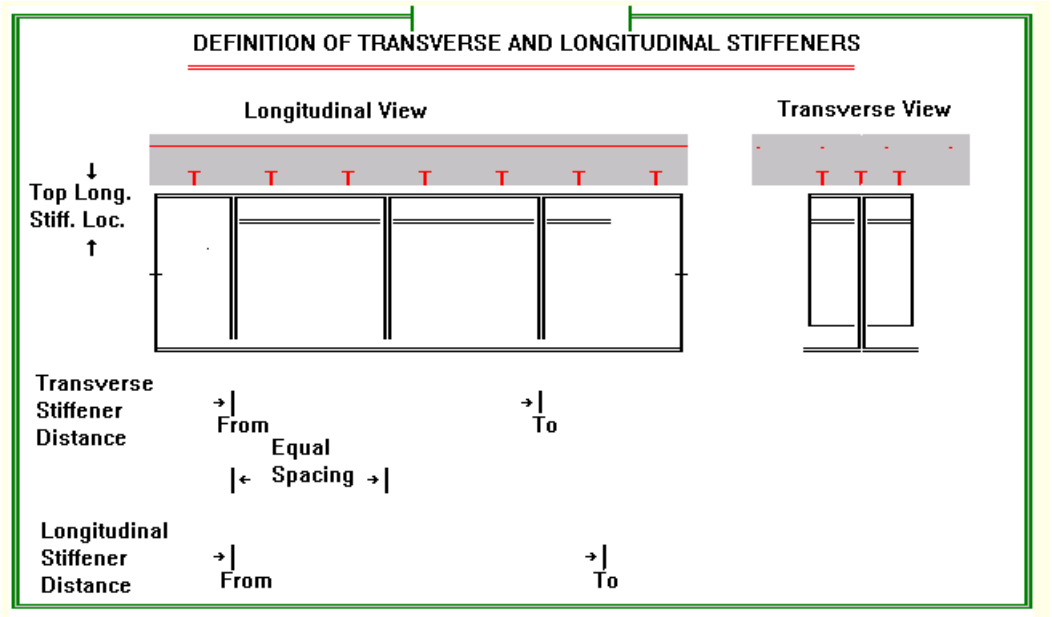


Table 4.39 : Longitudinal Stiffener Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
14012	***Location, Distance From/To :*** Distance measured from the left bridge support FROM and TO the span interval for which longitudinal data is given.	**Ft (m)**	**REAL**	**OPT.**	
	Yield Stress, Fy : Yield stress of the stiffener material for the given FROM/TO span interval.	**Ksi (MPa)**	**REAL**	**OPT.**	
	Top Stiffener Data, Location : Location of the longitudinal stiffener given as a fraction or the clear web depth measured from just below the top flange. **Example :** For a web with a depth of 45 in. and having a longitudinal stiffener located 9 in. from the top flange, input the fraction 9/45 as the decimal 0.2 or plainly input 9in.	**NONE or in (mm)**	**REAL**	**OPT.**	
	Stiffener Width : Width of the top longitudinal stiffener.	**in (mm)**	**REAL**	**OPT.**	
	Stiffener Thickness : Thickness of the top longitudinal stiffener.	**in (mm)**	**REAL**	**OPT.**	
	Bottom Stiffener Data, Location; Width and Thickness : Location of the bottom longitudinal stiffener given as a fraction or the clear web depth measured from just above the bottom flange. Input for width and thickness same as above.	**NONE or in (mm)**	**REAL**	**OPT.**	

4.2.9C Transverse Stiffener (For Steel bridges only) (Data Type 15012)

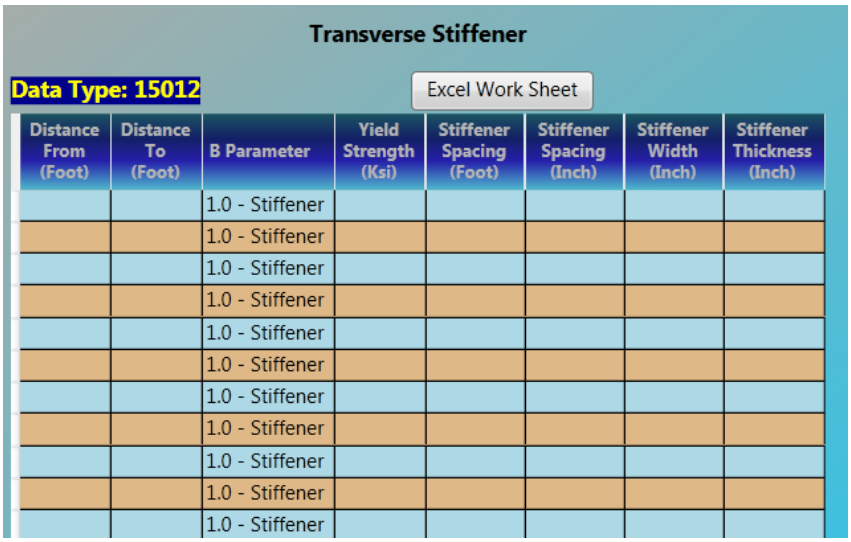


Table 4.40 : Transverse Stiffener Data Input Description

DATA TYPE	INPUT ITEM/DESCRIPTION	UNITS	MODE	REQ/ OPT.	REF.
15012	***Location, Distance From/To :*** Distance measured from the left bridge support FROM and TO the span interval for which transverse stiffener data are given. Both FROM and TO distances are given when specifying actual stiffener spacing. An individual stiffener may be located by giving the DISTANCE TO the stiffener as measured from the bridge support.	**Ft (m)**	**REAL**	**OPT.**	
	B Parameter : Value of B required by AASHTO Spec., Section 10.34.4.7, as follows : B = 1.0 for stiffener pairs **(Default)** B = 1.8 for single angles B = 2.4 for single plates Although the B parameter is referenced in the LOAD FACTOR specifications, a value is needed for WORKING STRESS DESIGN to compute the stiffener properties.	**NONE**	**REAL**	**OPT.**	**REF.1**
	Yield Stress, *Fy*: Yield stress of the stiffener materials for the given FROM/TO span interval.(Default is 36 ksi or 248 Mpa)				
	Stiffener Spacing: Stiffener spacing within the FROM/TO span interval.				
	Stiffener Width: Width of the transverse stiffeners.				
	Stiffener Thickness: Thickness of the transverse stiffener.				

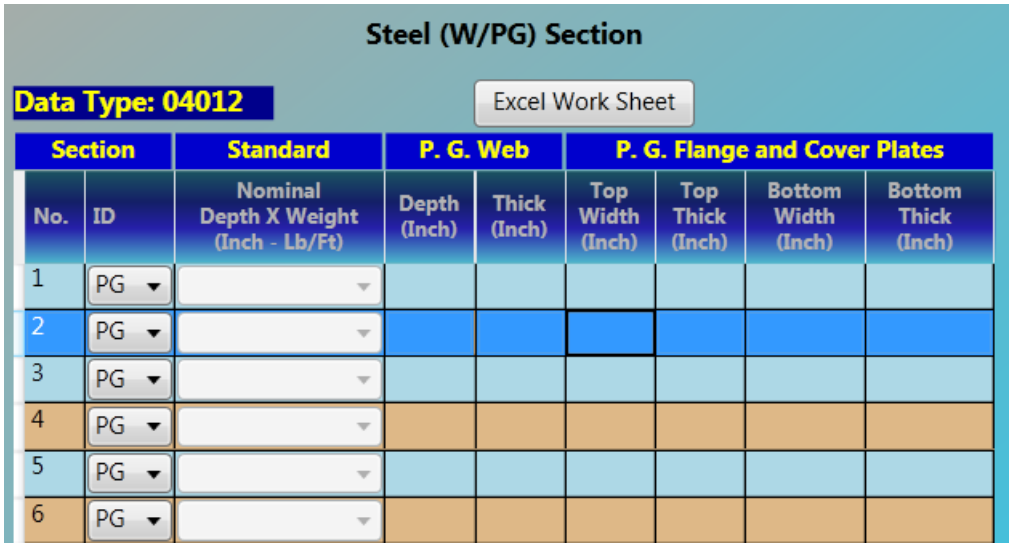
Use Excel Work Sheet to Enter Data

Some data input pages have Excel Work Sheet button on top. Click this button to launch Microsoft Excel with a predefined template XLS file for this data type. User can enter data into the XLS file then paste them back to Data Input Page by pressing Ctrl+V.

Copy Data From Excel: When data entering is done in Excel, select data cells as shown below and press Ctrl+C.

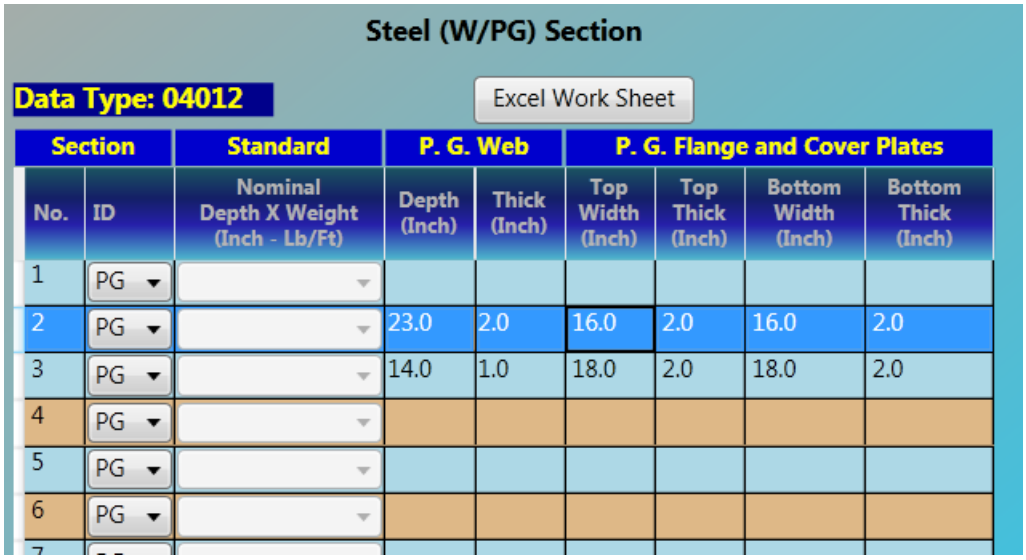
1	**Steel Beam Definition**							**Data Type: 04012**	
2	Input Description:								
3	Section No.				Integer				
4	Section ID				Alpha		W or PG		
5	Standard Sections Nominal				Integer		Nominal depth of the AISC section		
6	Standard Sections Weight				Real		Nominal weight of the AISC section		
7	Plate Girders Web Depth and Thickness				Real		Web depth and thickness of the plate gir		
8	Cover Plates and Plate Girder								
9	Top/Bottom Plate Width and Thickness				Real		The width and thickness of the top/bottom		
10									
11	**Section**		**Standard Sections**	**Plate Girders**		**Cover Plates & Plate Girder**			
12	**No**	**ID**	**Nominal Depth X Weight**	**Web Depth(in or mm)**	**Web Thickness (in or mm)**	**Top Plate Width (in or mm)**	**Top Plate Thick (in or mm)**	**Bottom Plate Width (in or mm)**	**Bottom Plate Thick (in or mm)**
13	1			23	2	16	2	16	2
14	2			14	1	18	2	18	2
15									
16									

Go back to the Data Input Page and highlight a row starting from which data will be copied by clicking any cell in that row. The following screen capture shows the second row is highlighted. (Data will be copied to row 2 and 3.)



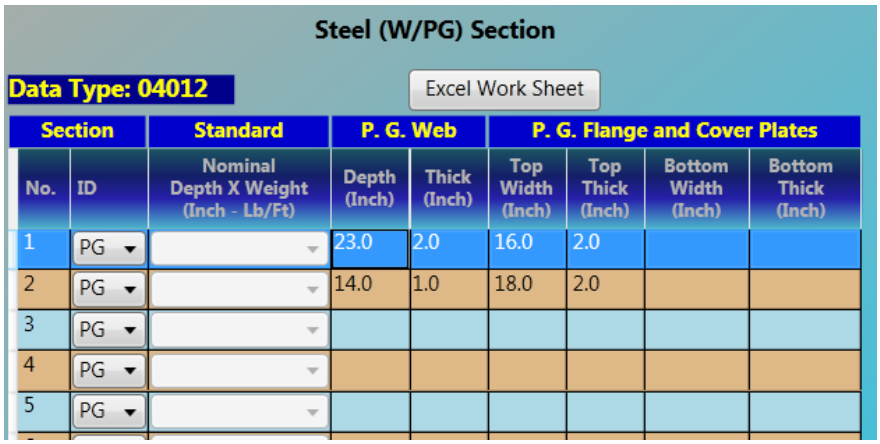
Press Ctrl+V to paste data as shown below.
Note: Read only columns such as No. will be ignored and skipped.

Cells matching: Data will be read from the first row and first column of selected area in Excel. The first row of selected Excel area matches the selected row in the Data Page. The first column of selected Excel area matches the first column in the Data Page. If a column in the Data Page is read only,it will be skipped and the corresponding cell in Excel area will be ignored. When cells in Excel area reach end, matching will start at next row in the Data Page.

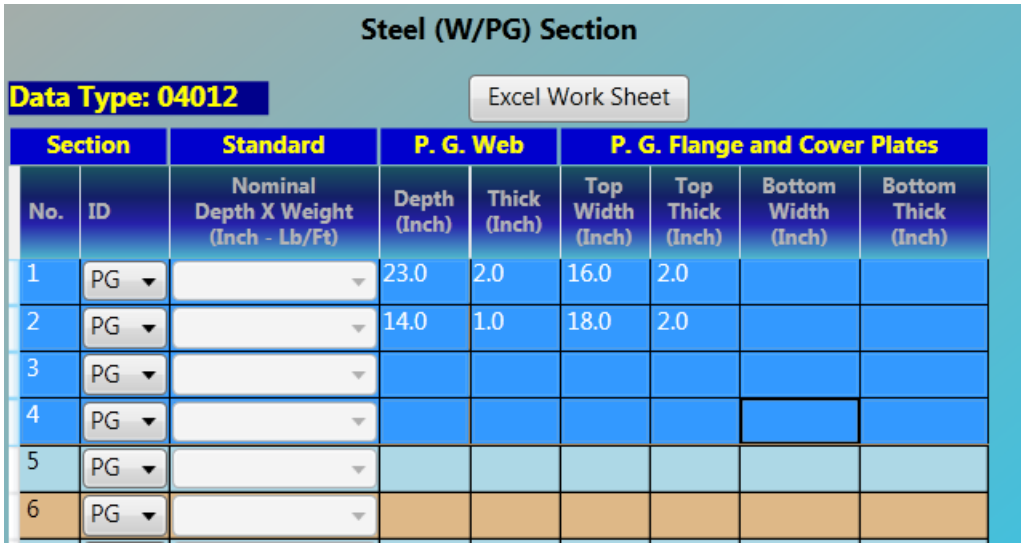


For example, if the cells area is selected as below and the first row in Data Page is selected, the last two columns will be left as is after pasting.

	Section		Standard Sections	Plate Girders		Cover Plates & Plate Girder			
	No	ID	Nominal Depth X Weight	Web Depth(in or mm)	Web Thickness (in or mm)	Top Plate Width (in or mm)	Top Plate Thick (in or mm)	Bottom Plate Width (in or mm)	Bottom Plate Thick (in or mm)
13	1			23	2	16	2	16	2
14	2			14	1	18	2	18	2



Copy Data From Data Input Page: Click any cell in a row to select a row in Data Page or click any cell while holding SHIFT key to select multiple rows, press Ctrl+C to copy selected data into Clipboard. Then use Paste function (Ctrl+V) to copy it to most Windows applications including Excel and Word. The following two captures shows a selection in Data Page and that in Excel after pasting.

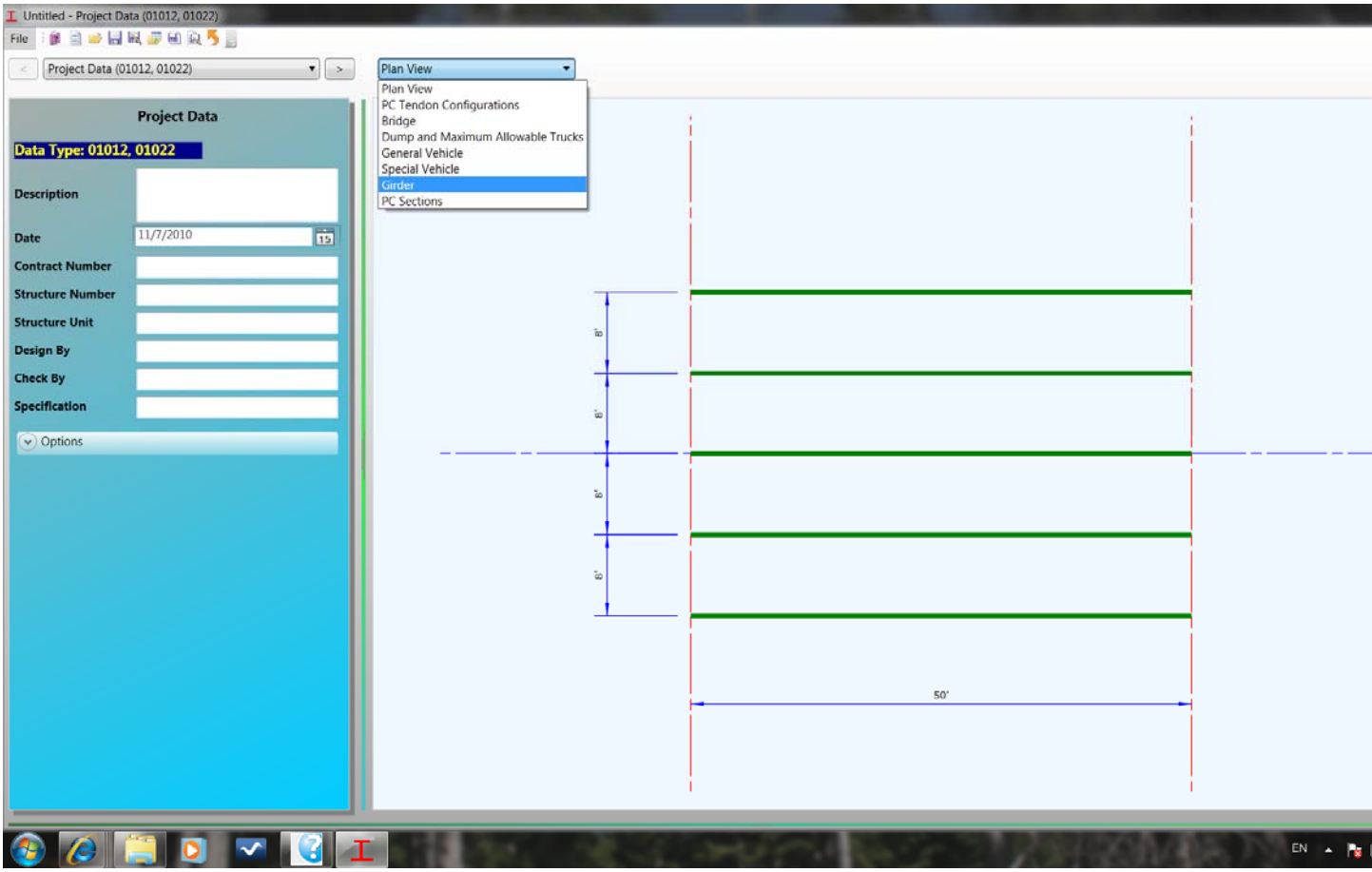


1			23	2	16	2		
2			14	1	18	2		
3								
4								

4.3 Graphic Pages

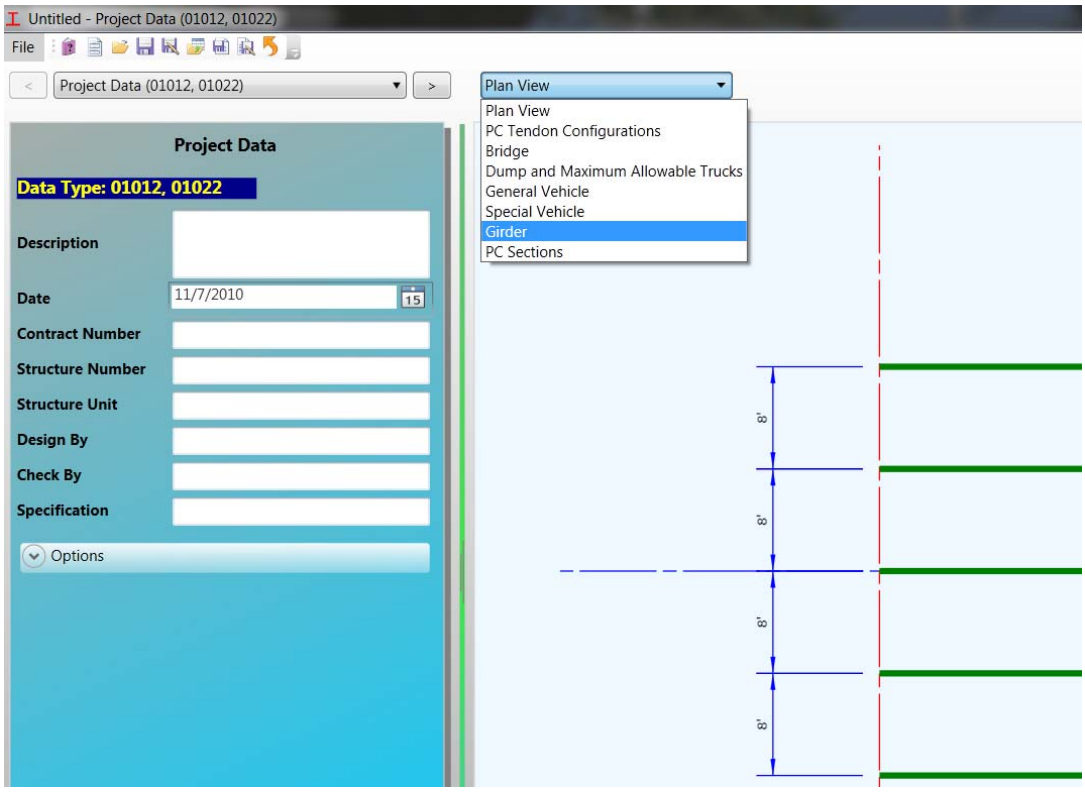
Graphic pages are used to show different aspect of a bridge model, such as Plan View, Bridge, Sections, Girder, Girder Profile and Loads, PC Tendon Configurations and Trucks. When data is entered or modified in some Data Input Pages, graphic pages will be automatically refreshed.

Graphic Pages are shown on the right of the window. To view a graphic page, you need to Navigate to a Graphic Page first.

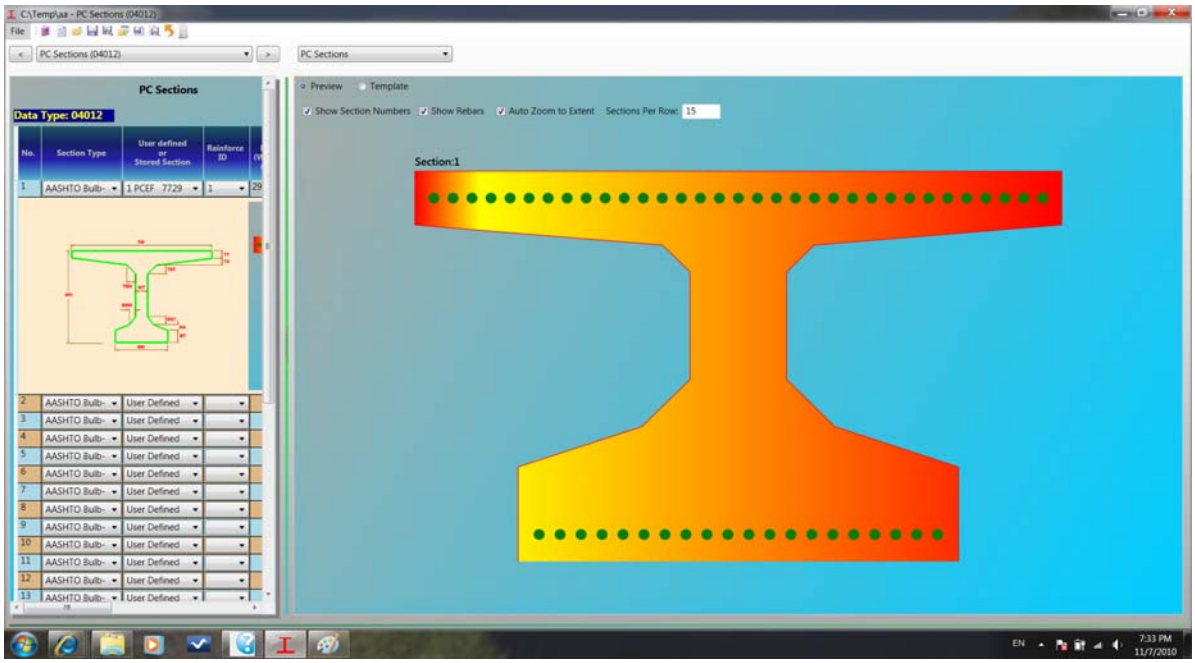


4.3A Navigate to a Graphic Page

To view a graphic page, select the page name from the drop down list as shown below.

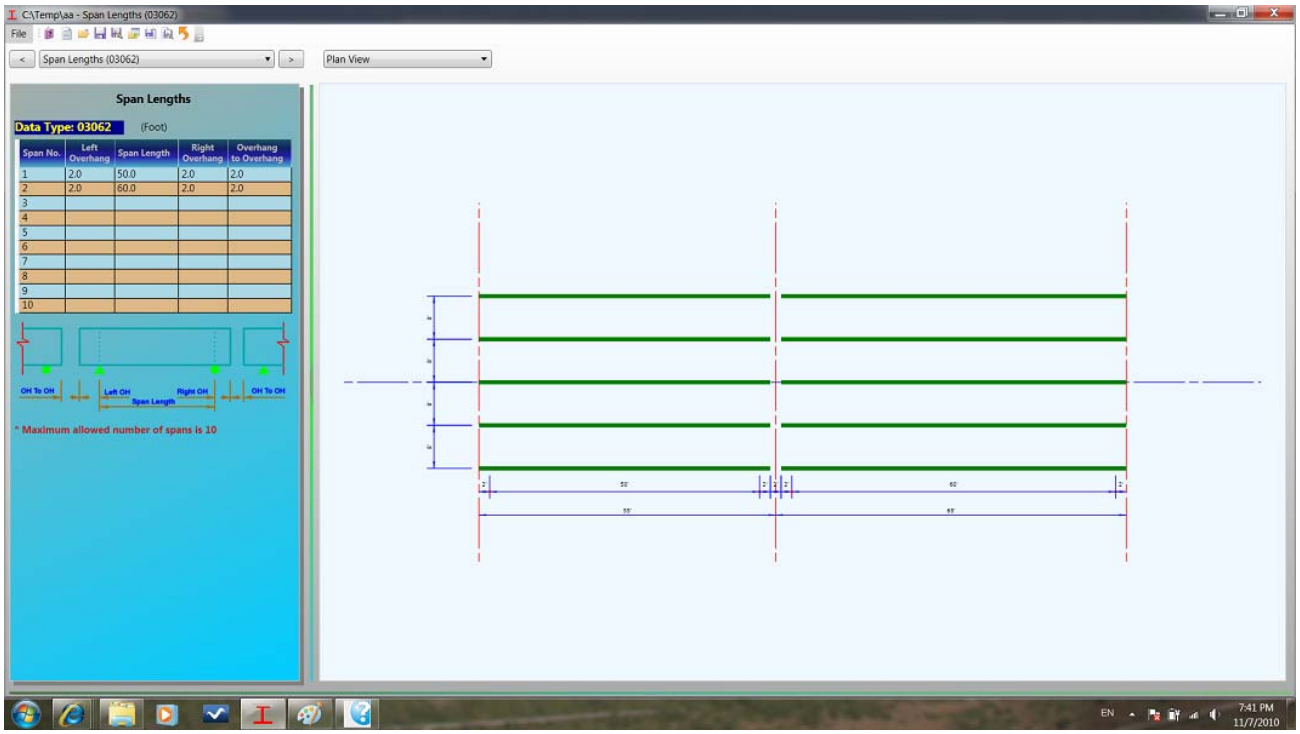


Some Graphic Pages are linked to some Data Input Pages. When a linked data input page is navigated, the correspondent graphic page will be automatically navigated. For example, the following screen capture shows that RC Sections is automatically opened when PC Sections (Data Type 04012) is navigated on the left of the window.



4.3B Plan View

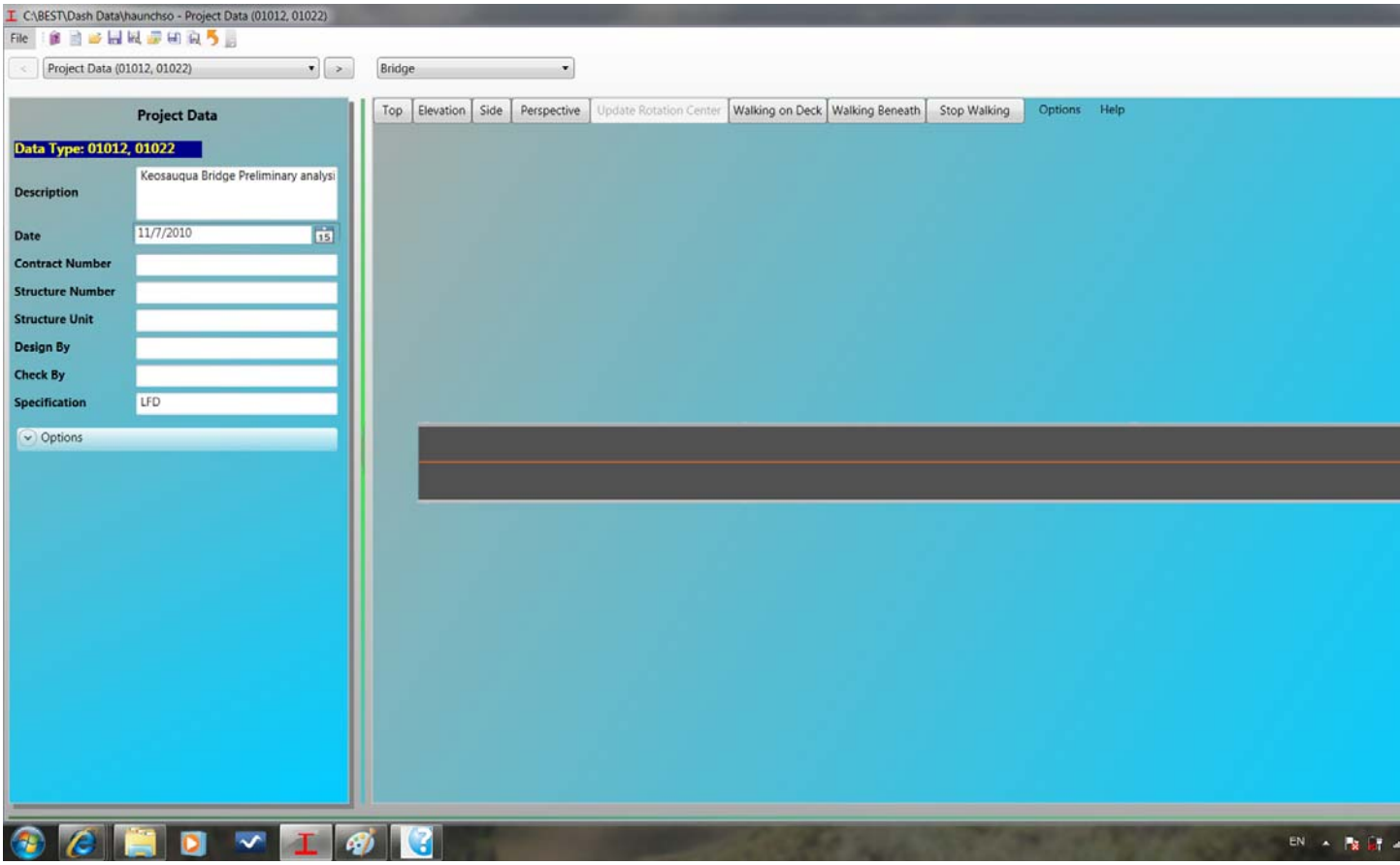
Plan View shows the span and beam layout in plane view. The following example shows a plan view of a two span PC bridge.



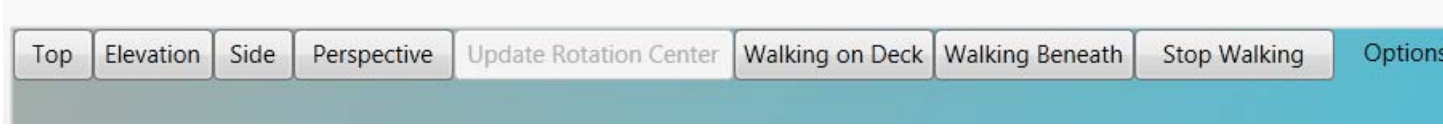
4.3C Bridge

Bridge view is a 3D graphics rendering of a bridge. The 3D rendering truly reflects the bridge geometry data entered in Data Input Pages, such as span lengths, beam spacings, girder dimensions, diaphragm locations, stiffener locations,deck width and thick. Some other secondary geometries are faked. For example, diaphragm details, rails and substructures, are all assumed by default dimensions.

The following capture shows the bridge view of a bridge.

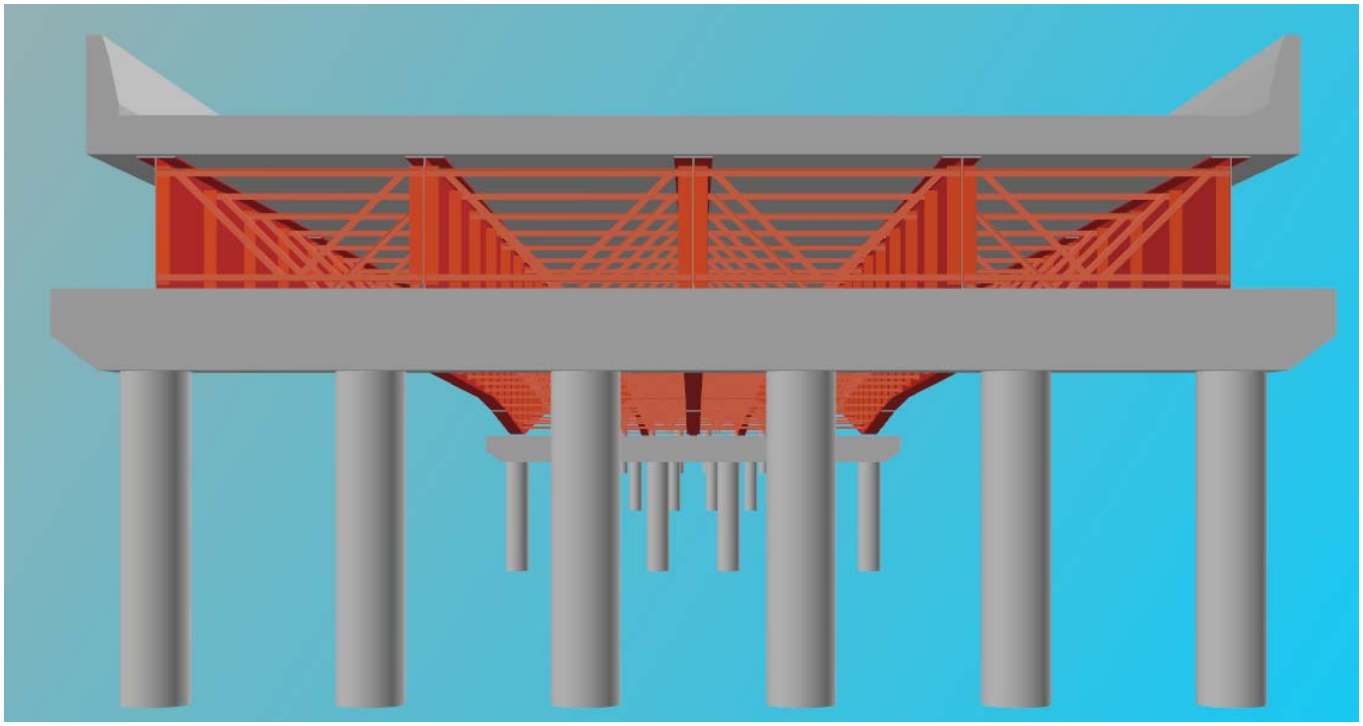


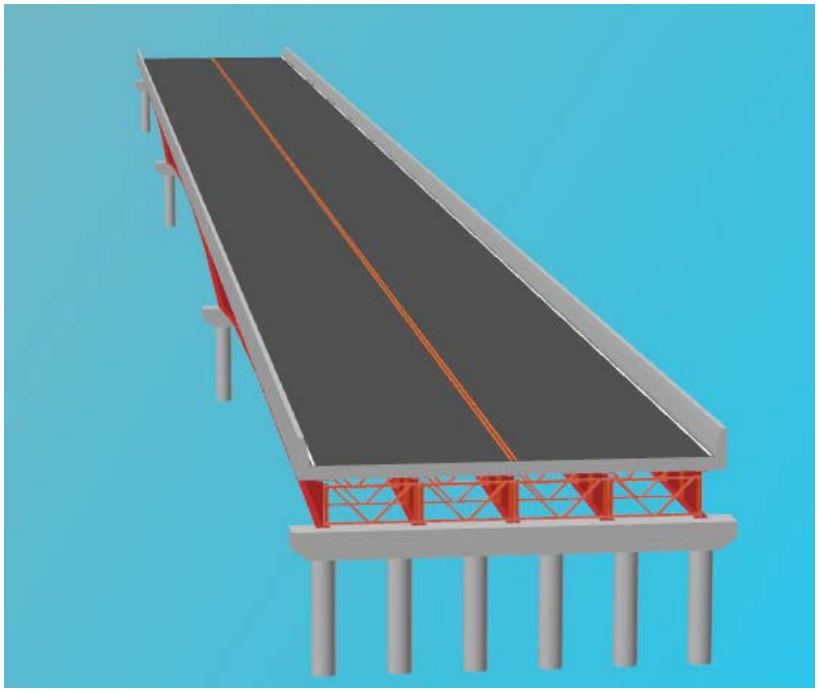
On top of bridge view, there are several buttons and options as shown below.



Top - To view the bridge on top. An example of top view of a bridge is showing in above.
Elevation - To view the bridge in elevation.
Side - To view the bridge from side.
Perspective - To view the bridge in perspective.

The following captures show a bridge elevation, side view and perspective view.



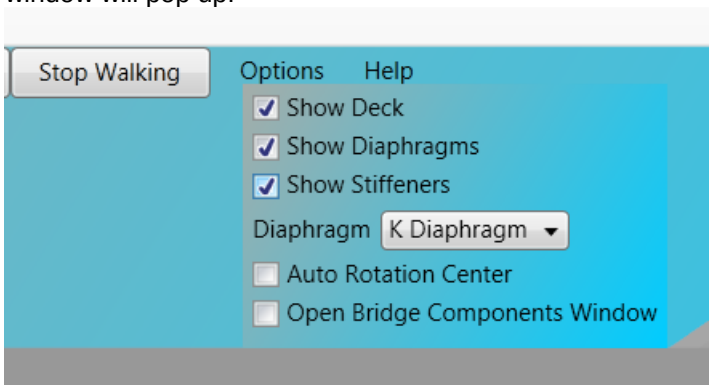


Walking on Deck - To simulate walking on bridge deck, an animation of bridge simulating walking on deck.

Walking Beneath - To simulate walking beneath bridge, an animation of bridge simulating walking beneath the bridge.

Stop Walking/Resume Walking - To stop or resume the animation.

Options - Change options of 3D bridge rendering. Move cursor over **Options** on top, the following window will pop up.



Show Deck - Check to show deck or uncheck to remove deck.

Show Diaphragms - Check to show diaphragms or uncheck to remove diaphragms.

Show Stiffeners - Check to show stiffener plates or uncheck to remove it.

Diaphragms - Select one of the following diaphragms: **K Diaphragms**, **Invert K Diaphragms**, **Cross Diaphragm** and **Plate Girder.**

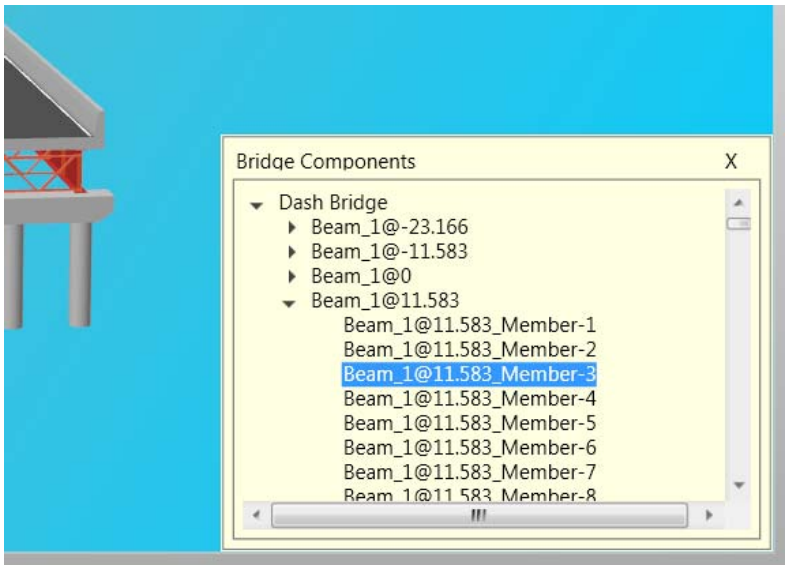
The Following capture shows a bridge without deck, diaphragms and stiffeners.

Auto Rotation Center - Check to automatically update the 3D rotation center whenever components in the scene are changed. Uncheck to keep rotation center unchanged. When **Auto Rotation Center** is unchecked, **Update Rotation Center** will be enabled. Click it to manually update the rotation center. See Interactive in 3D Graphic View for details.

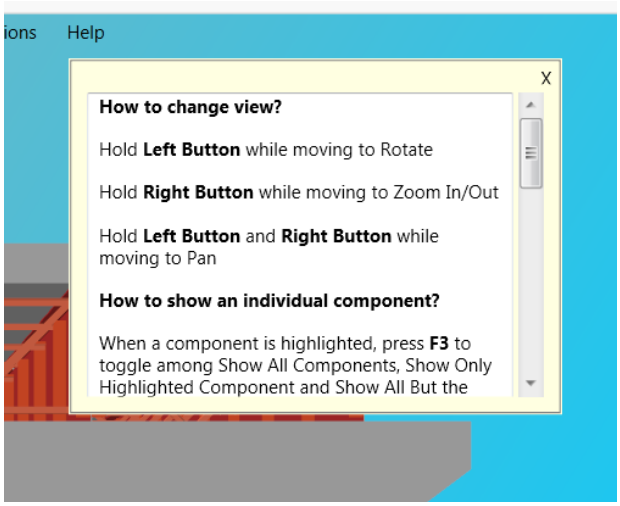
Open Bridge Component Window - Check to open the **Bridge Component Window** as shown below or uncheck to close it. This window can also be closed by clicking the cross on the title bar as shown below.

In the **Bridge Component Window**, all bridge components are listed as a tree with **Dash Bridge** as the root. Expand and browse the list to locate a bridge component. When a component is highlighted in the list, it will become the **Current Bridge Component**. The Current Bridge Component will be highlighted in the 3D scene also. When cursor hover over any component in the 3D scene, its correspondent item will be highlighted in the **Current Bridge Component**.

When the current bridge component is selected, the components in the scene can be set to **Only the Current Component**, **All Components but the Current Component** and **All Components**. These three states are toggled by pressing **F3**. See Interactive in 3D Graphic View for details.



Help - A brief help on interactive operations in 3D scene. Move cursor over **Help** on top, the following window will pop up. Move the cursor over the cross in the title bar to close it. See Interactive in 3D Graphic View for details about how to control the 3D view.


ions
Help
X
How to change view?
Hold Left Button while moving to Rotate
Hold Right Button while moving to Zoom In/Out
Hold Left Button and Right Button while moving to Pan
How to show an individual component?
When a component is highlighted, press F3 to toggle among Show All Components, Show Only Highlighted Component and Show All But the

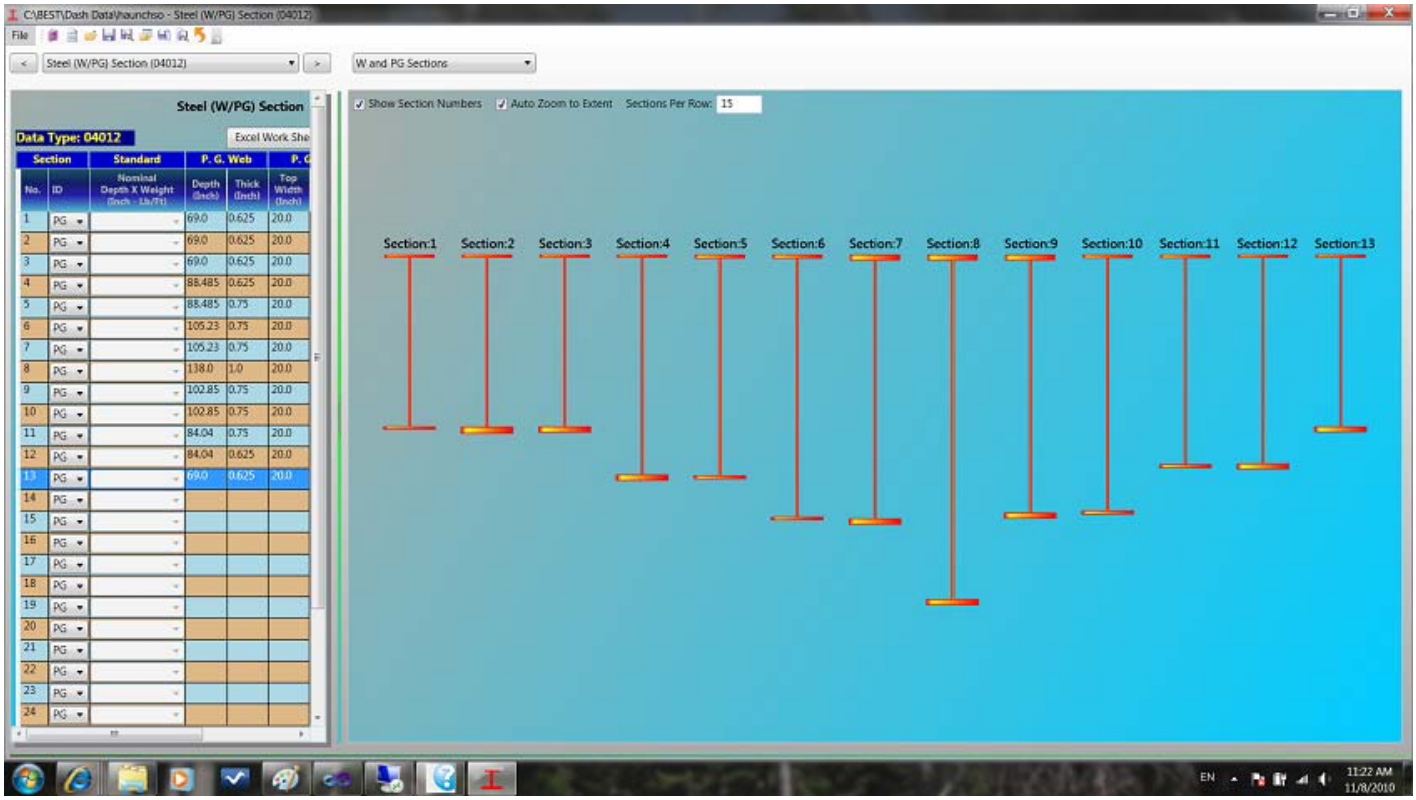
How to increase performance?

The performance of graphics rendering depends on end computers including CPU, memory and the most important - video card. For a given computer, turn off diaphragms and stiffeners in a steel bridge will increase the performance significantly.

4.3D Sections

Section Graphic Pages are used to display cross sections during entering of section data. It contains W/PG Sections for steel bridges, PC Sections for prestressed concrete bridges and RC Sections for reinforced concrete bridges.

4.3D.1 W/PG Sections



Navigate to Steel (W/PG) Section (Data Type 04012) from Data Input Pages area or select **W and PG Sections** in Graphic Pages area to open this page.

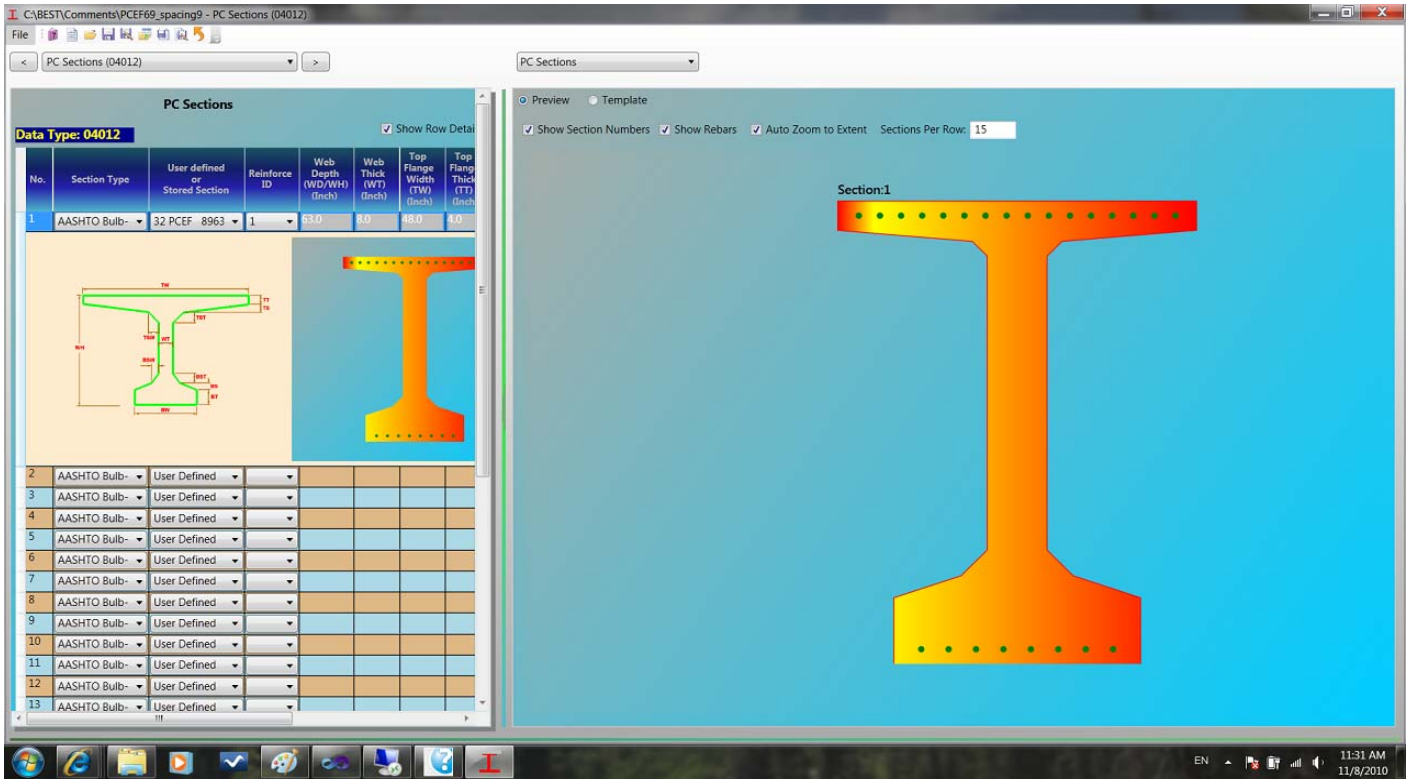
Show Section Numbers - turn on or off sections numbers on top of each section.

Auto Zoom to Extent - check to automatically zoom to full extent when a new section is added or modified in Steel (W/PG) Section (Data Type 04012).

Sections Per Row - enter a number of sections displayed per row.

See Zoom and Pan of a 2D Graphic View for more operations on 2D section view.

4.3D.2 PC Sections



Navigate to PC Sections (Data Type 04012) from Data Input Pages area or select **PC Sections** in Graphic Pages area to open this page.

Preview/Template - Select to show section preview as shown above or the section template of current section type.

Show Section Numbers - turn on or off of sections numbers on top of each section.

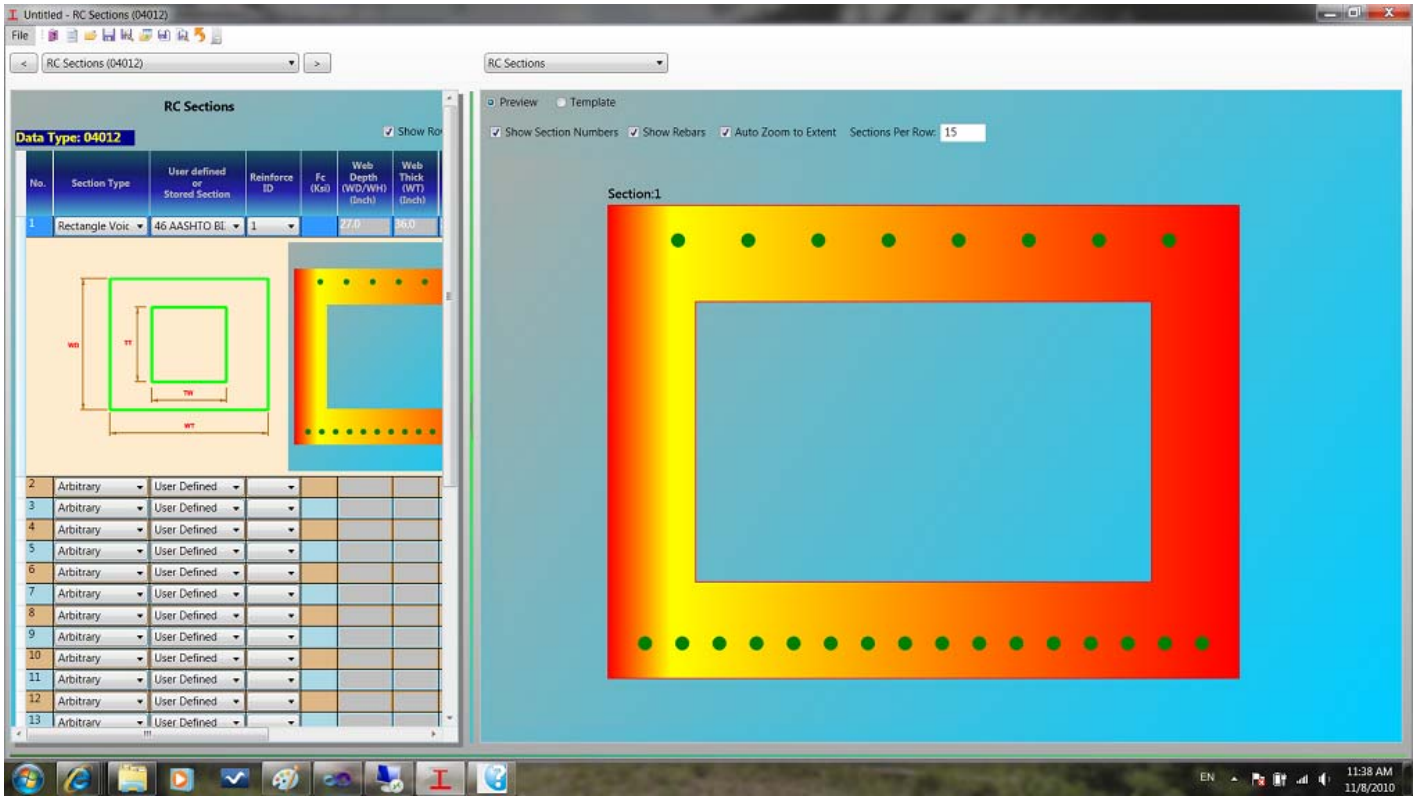
Show Rebars - turn on or off rebars.

Auto Zoom to Extent - check to automatically zoom to full extent when a new section is added or modified in PC Sections (Data Type 04012).

Sections Per Row - enter a number of sections displayed per row.

See Zoom and Pan of a 2D Graphic View for more operations on 2D section view.

4.3D.3 RC Sections



Navigate to RC Section (Data Type 04012) from Data Input Pages area or select **RC Sections** in Graphic Pages area to open this page.

Preview/Template - Select to show section preview as shown above or the section template of current section type.

Show Section Numbers - turn on or off of sections numbers on top of each section.

Show Rebars - turn on or off rebars.

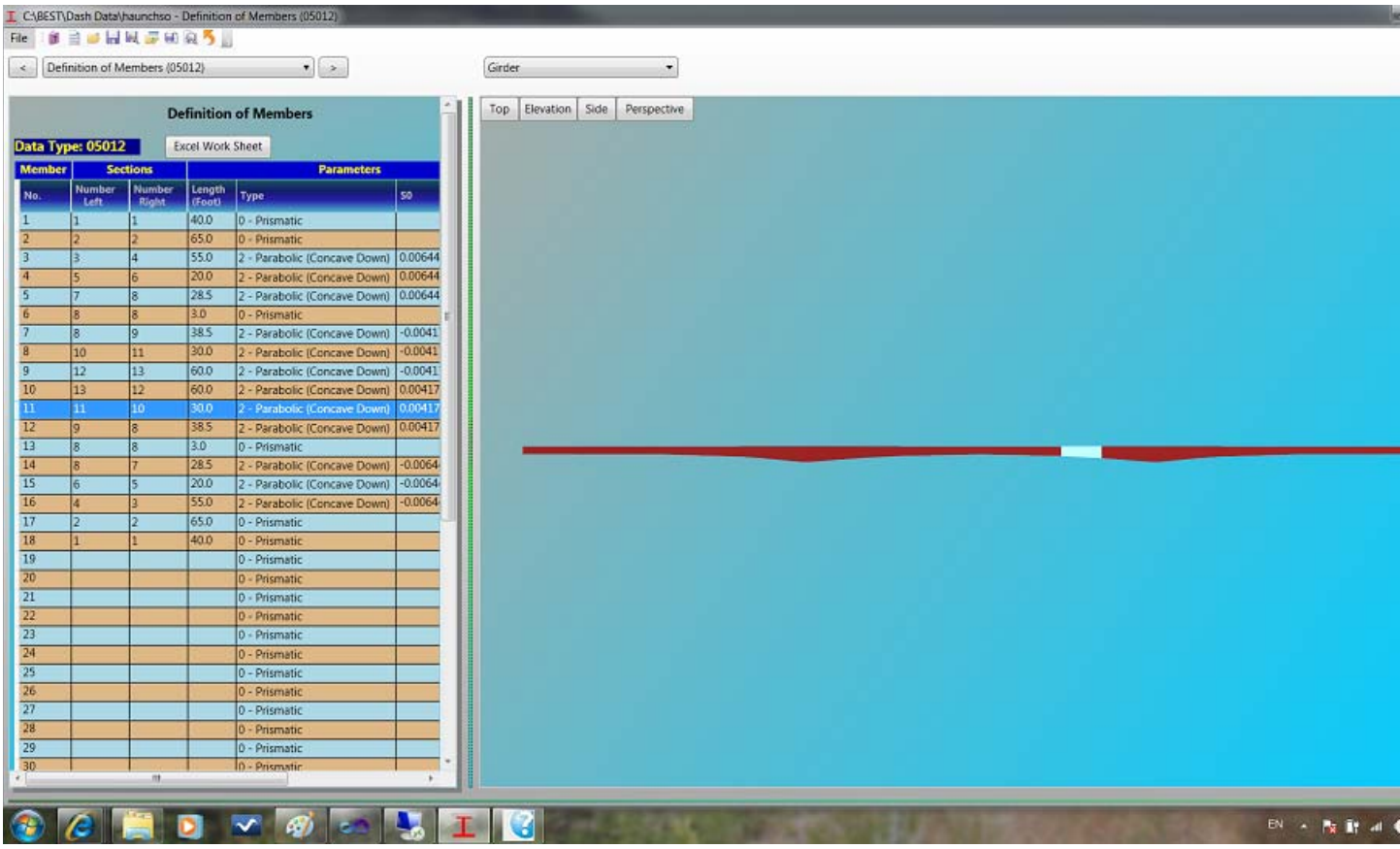
Auto Zoom to Extent - check to automatically zoom to full extent when a new section is added or modified in RC Section (Data Type 04012).

Sections Per Row - enter a number of sections displayed per row.

See Zoom and Pan of a 2D Graphic View for more operations on 2D section view.

4.3E Girder

Girder graphic page is used to display girder member definitions for steel bridges.



Select **Girder** in Graphic Pages area to open this page.

Top - To view the girder on top. An example of top view of a bridge is showing in above.

Elevation - To view the girder in elevation.

Side - To view the girder from side.

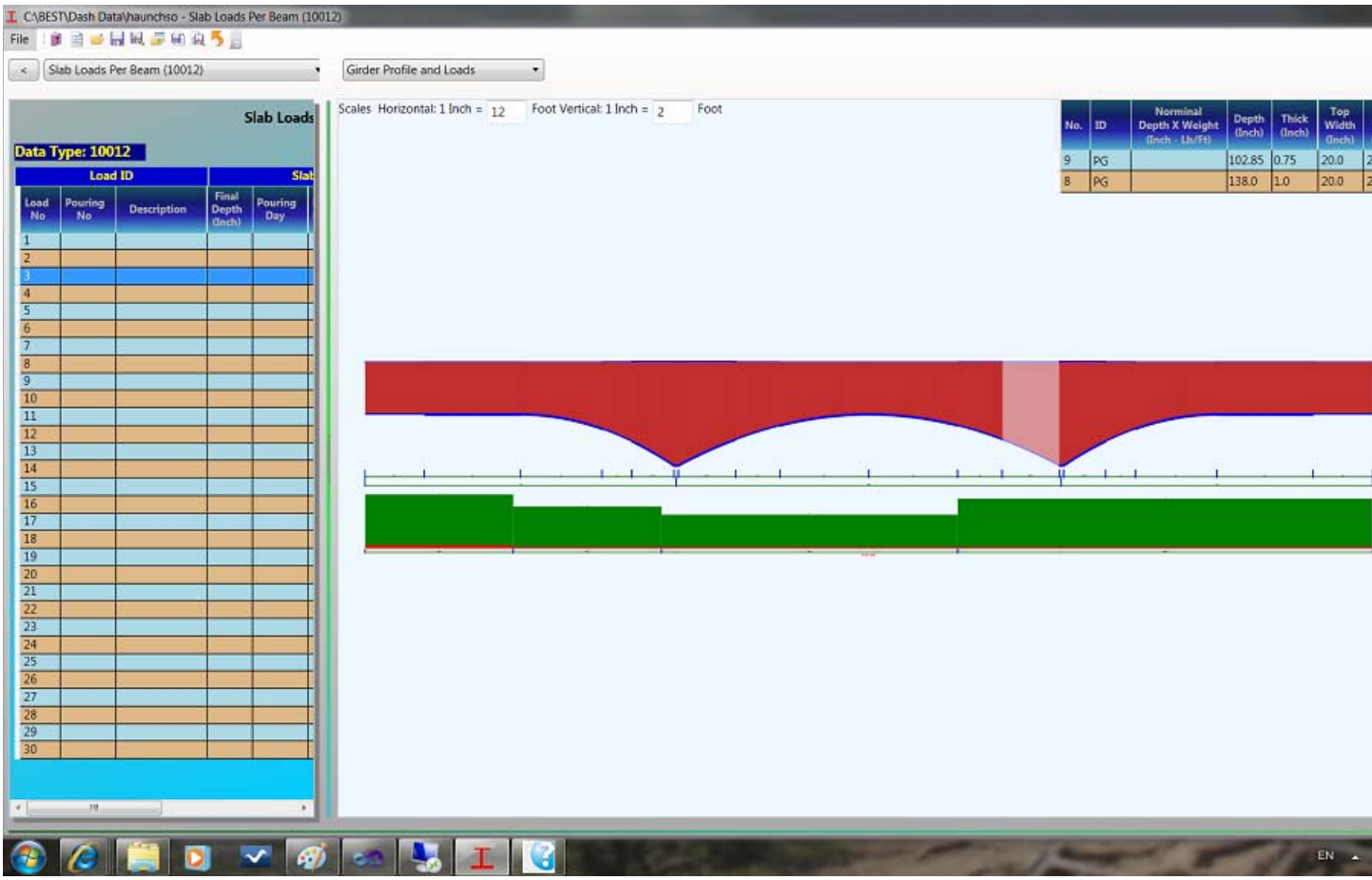
Perspective - To view the girder in perspective.

When hover the mouse over the girder, the current segment will be highlighted and it correspondent definition will be highlighted in Steel (W/PG) Section (Data Type 04012).

Girder is a 3D rendering and it shares same view operation with bridge, except that no component browsing. See Interactive in 3D Graphic View for more information about how to turn a view.

4.3F Girder Profile and Loads

Girder Profile and Loads graphic page is for steel bridges only.



Select **Girder Profile and Loads** in Graphic Pages area to open this page.

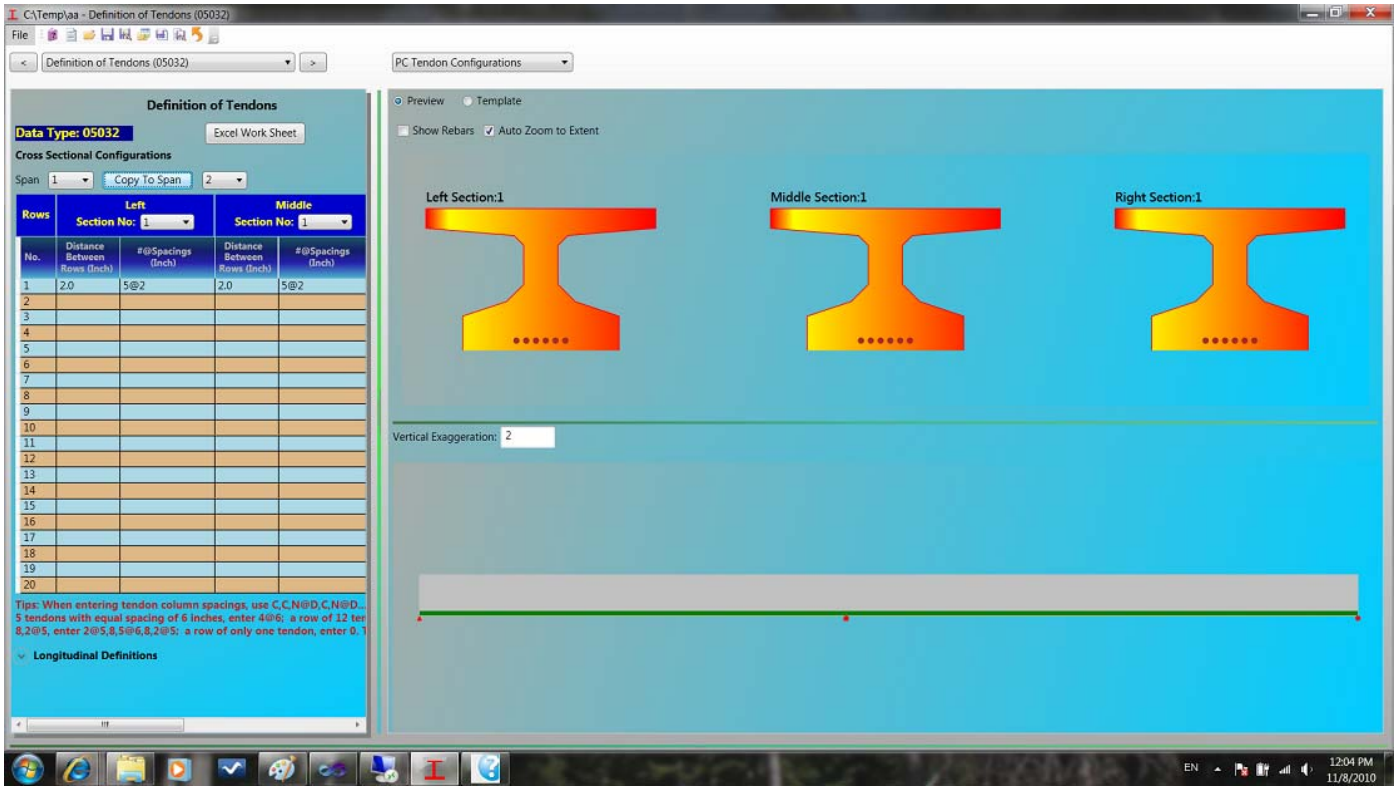
Girder profile can be generated in different scales in horizontal and vertical.
Scales Horizontal: - enter a scale for horizontal displaying.
Scales Vertical: - enter a scale for vertical displaying.

When hover the mouse over the girder, the current segment will be highlighted and it correspondent definition will be highlighted on top of the window.

See Zoom and Pan of a 2D Graphic View for details about operations on 2D graphics view.

4.3G PC Tendon Configuration

PC Tendon Configurations is used to show tendon definitions of PC bridges.



Navigate to Definition of Tendons (Data Type 05032) from Data Input Pages area or select **PC Tendon Configurations** in Graphic Pages area to open this page.

Preview/Template - Select to show section preview as shown above or the section template of current section type.

Show Rebars - turn on or off rebars.

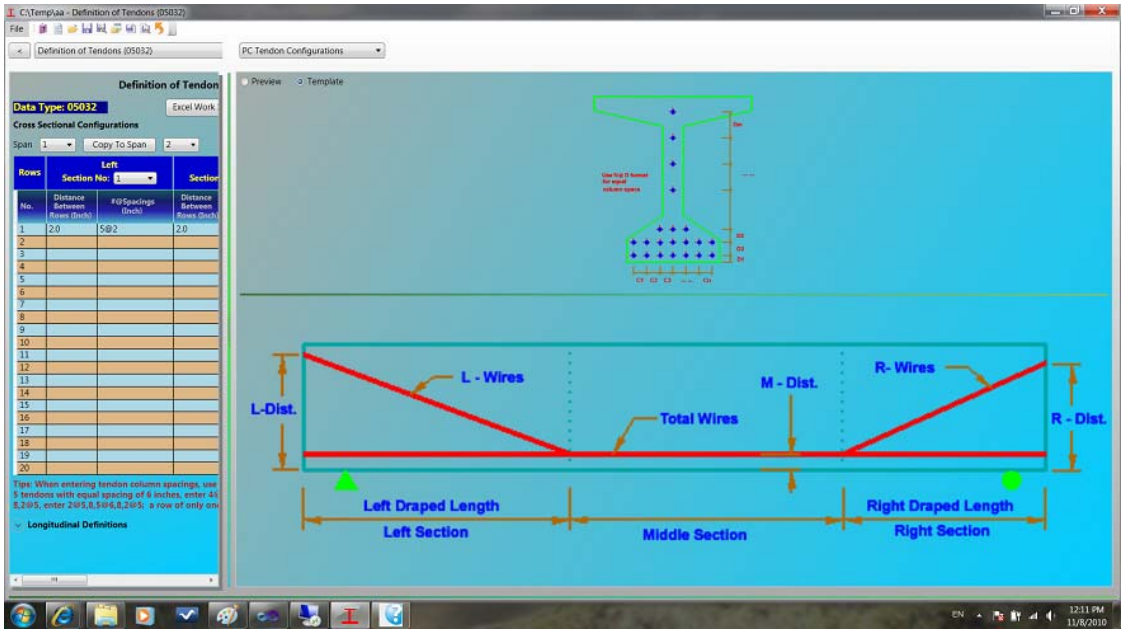
Auto Zoom to Extent - check to automatically zoom to full extent when a new section is added or modified in Definition of Tendons (Data Type 05032).

Vertical Exaggeration - enter a factor to exaggerate the girder profile.

Grab the green horizontal line to adjust areas of section view and girder profile view.

See Zoom and Pan of a 2D Graphic View for more operations on 2D section view.

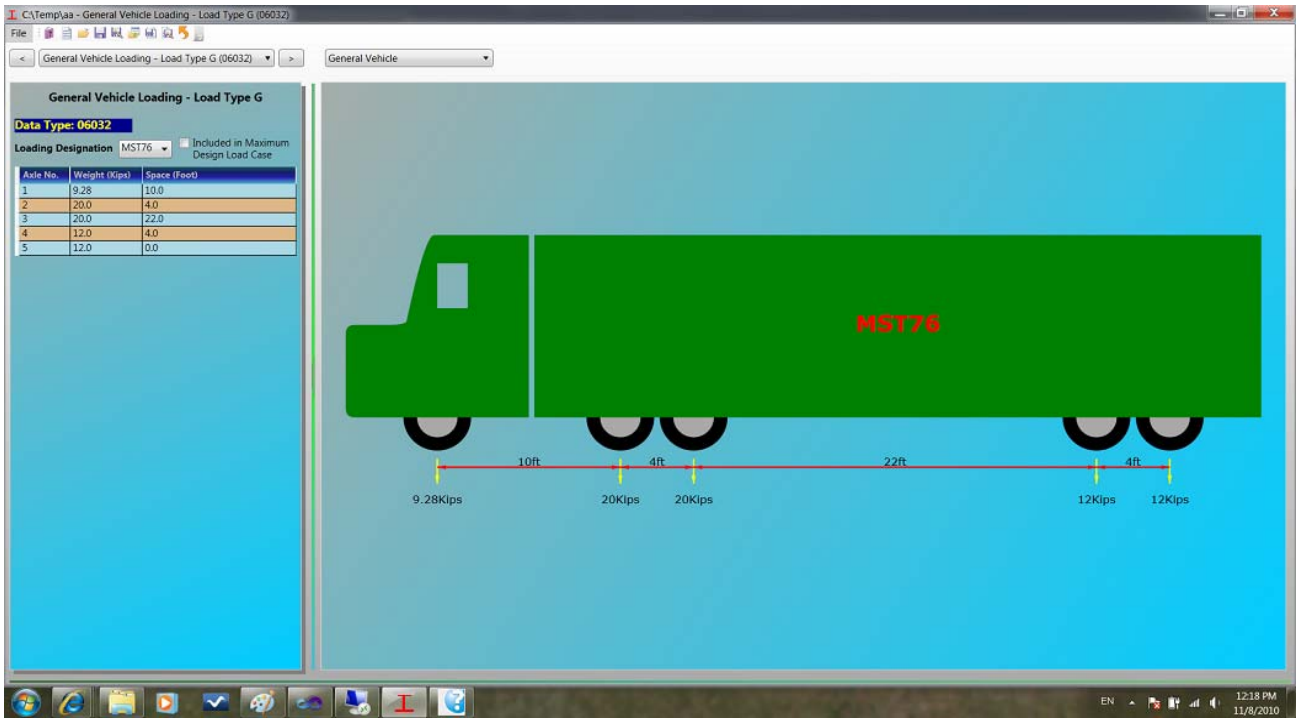
The following capture shows tendons definition template.



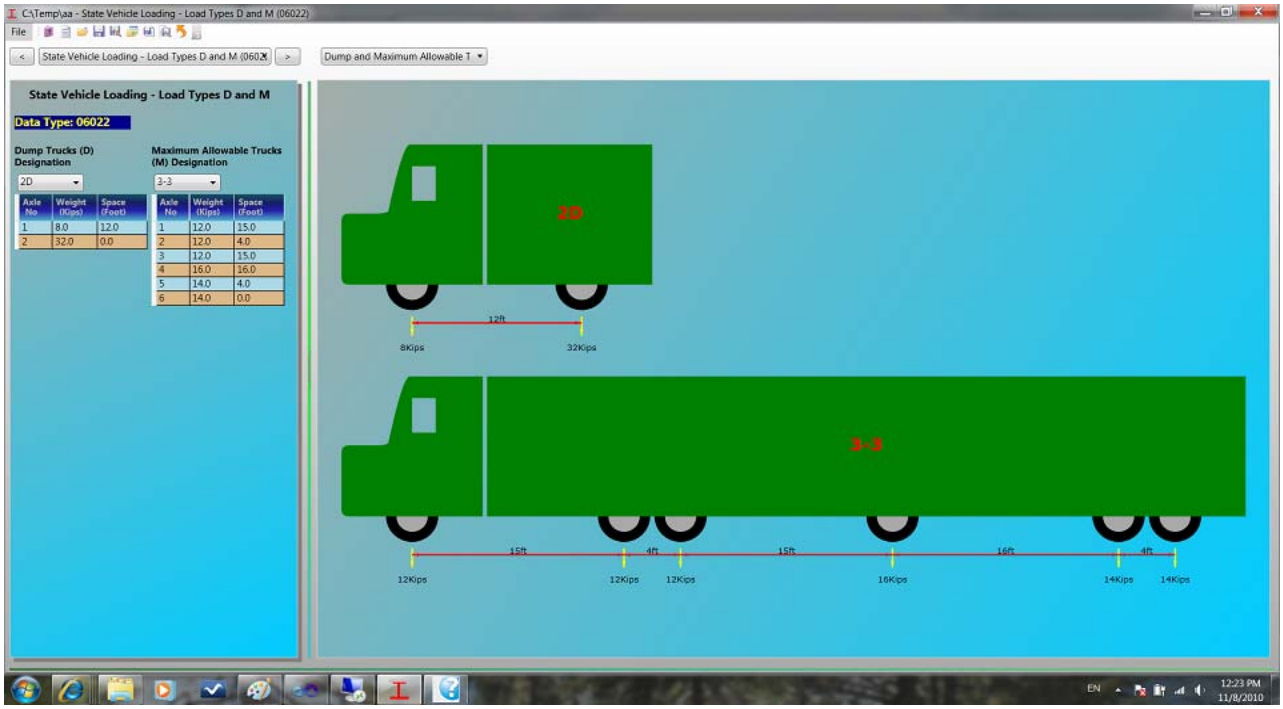
4.3H Trucks

Trucks graphic pages are used to illustrate the live load definitions. It contains General Vehicle, Dump and Allowable Truck and Special Vehicle.

4.3H.1 General Vehicle



4.3H.2 Dump and Allowable Truck

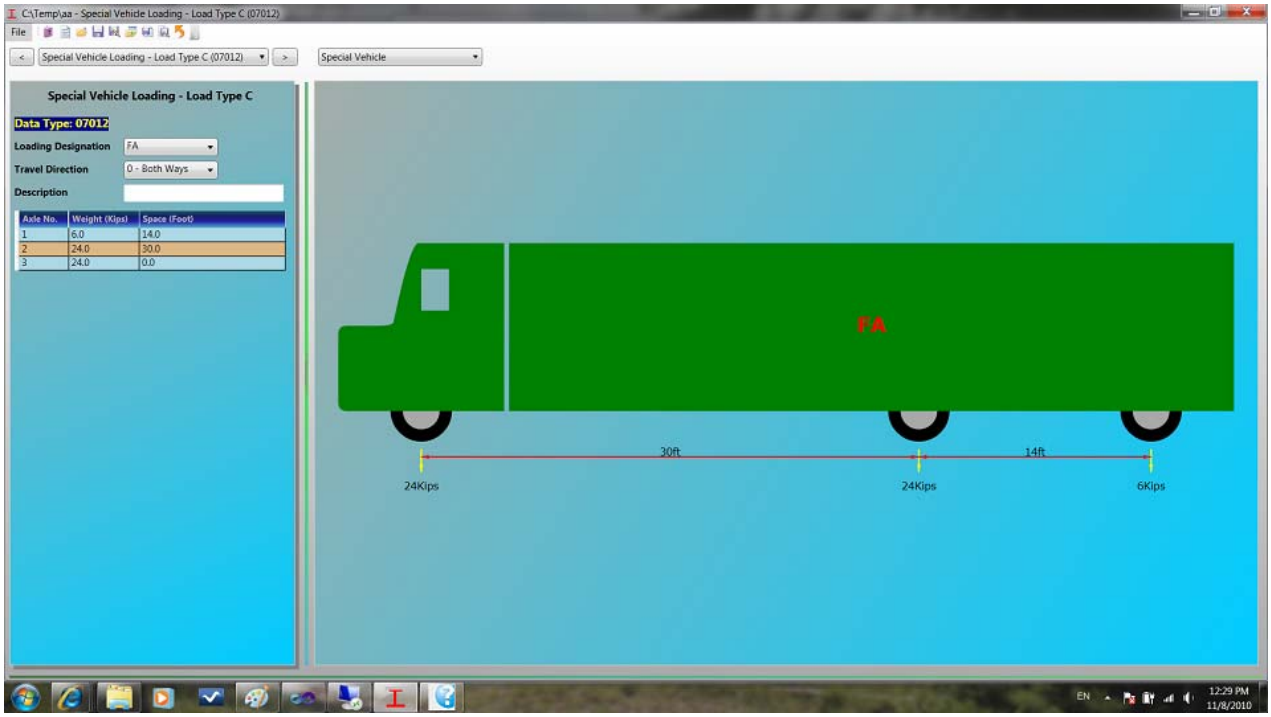


Navigate to State Vehicle Loading - Load Types D and M (Data Type 06022) from Data Input Pages and select **Dump and Maximum Allowable Trucks** in Graphic Pages area to open this page.

Select live loads in **Dump Trucks(D) Designation** and **Maximum Allowable Trucks(M) Designation** to illustrate the trucks if no live loads are defined for **Load Types D and M**.

See Zoom and Pan of a 2D Graphic View for more operations on 2D section view.

4.3H.3 Special Vehicle



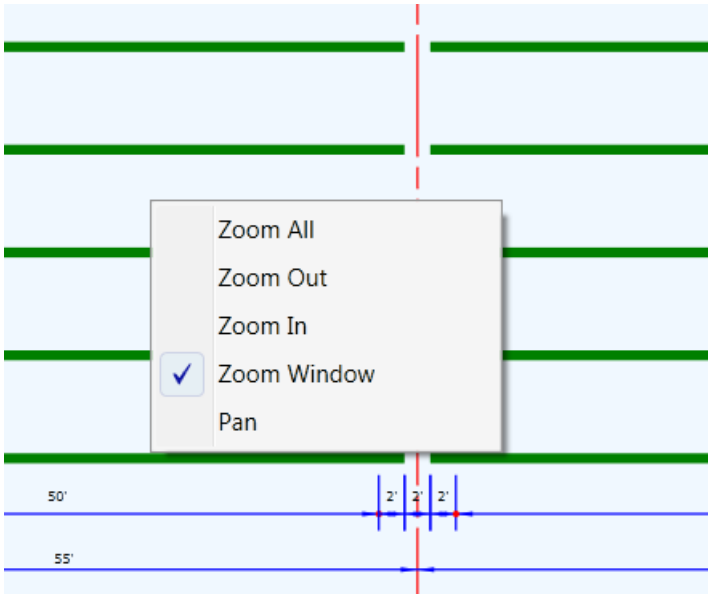
Navigate to Special Vehicle Loading - Load Type C (Data Type 07012) from Data Input Pages or select **Special Vehicle** in Graphic Pages area to open this page.

Select a live load in **Loading Designation** to illustrate the truck if no live load is defined for **Load Type C**.

See Zoom and Pan of a 2D Graphic View for more operations on 2D section view.

4.3I Zoom and Pan of a 2D Graphic View

Right click over any area of a 2D graphic view, a menu as shown below will open.

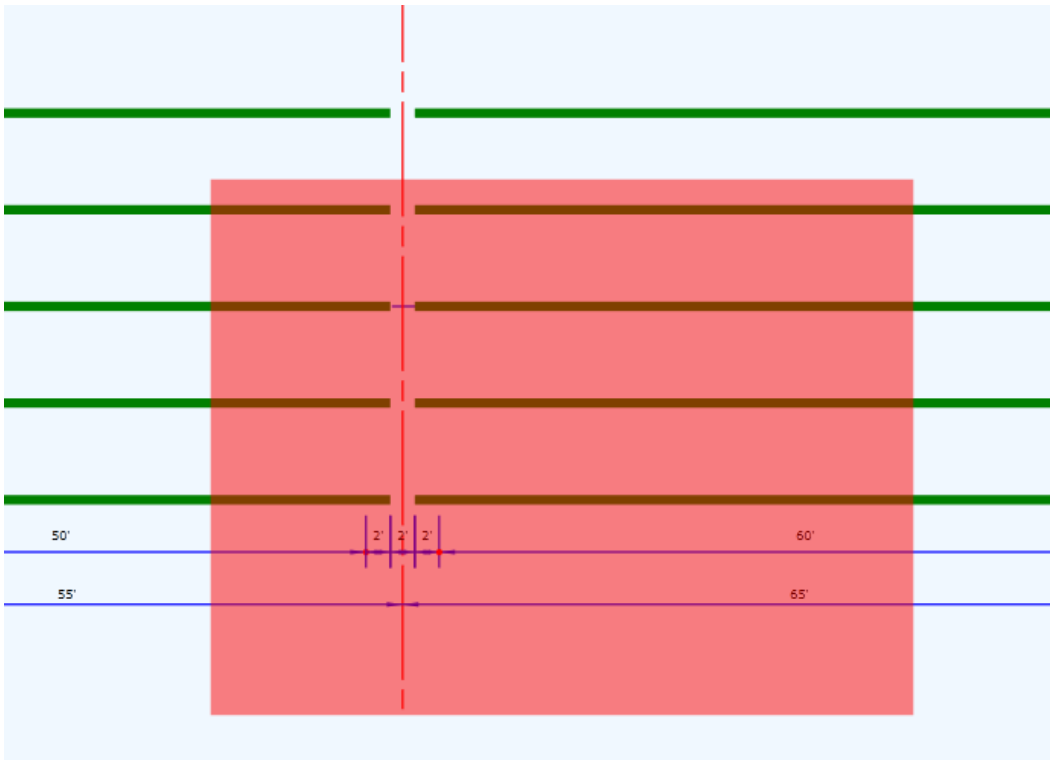


Zoom All - Select **Zoom All** to change the view to full extent.

Zoom Out - Select **Zoom Out**, then move cursor over a point and click left button, to zoom out the view. The view will be centered at the point where the mouse is clicked.

Zoom In - Select **Zoom In**, then move cursor over a point and click left button, to zoom in the view. The view will be centered at the point where the mouse is clicked.

Zoom Window - Select **Zoom Window**, then move cursor to one corner and drag the mouse (hold left button while moving cursor) to another corner. A pink rectangle as shown below will be showing while mouse is dragging. Release left button, the view will be zoomed to that rectangle.



Pan - Select **Pan** and then drag the view to pan the view.

When **Zoom Out**, **Zoom In**, **Zoom Window** or **Pan** is selected, it will be set as current command. The same operation can be performed without selecting again.

4.3J Interactive in 3D Graphic View

How to change view?
Hold **Left Button** while moving to Rotate
Hold **Right Button** while moving to Zoom In/Out
Hold **Left Button** and **Right Button** while moving to Pan

How to show an individual component?
When a component is highlighted, press **F3** to toggle among Show All Components, Show Only Highlighted Component and Show All But the Highlighted Component

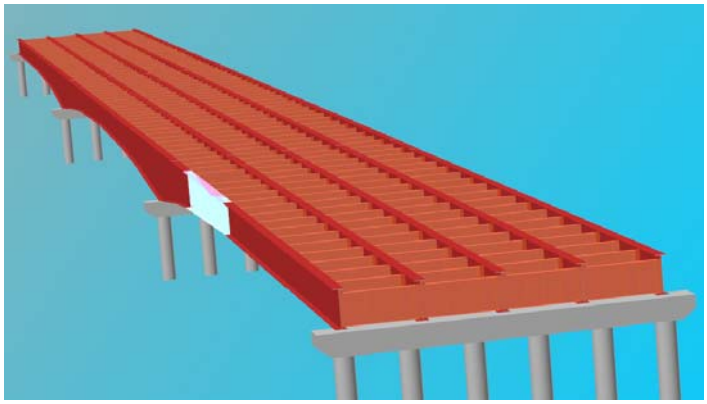
How to Zoom To an individual component?
When a component is highlighted, press **F2** to Zoom To the Highlighted Component

Preset Views
Click **Top** , **Elevation** , **Side** and **Perspective** buttons to change to preset views

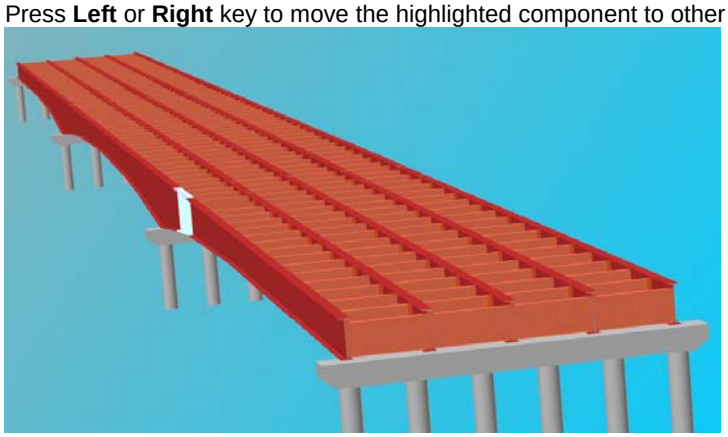
When components in scene are changed
The rotation center is always set to the center of scene (when **Auto Rotation Center** is checked). Rotation may appear abrupt when components are changed as the rotation center changes. A preset view may be needed to restore the view. This is true when scene is changed from local small component to global big components. Uncheck **Auto Rotation Center** and press **Update Rotation Center** when scene changes to bigger to avoid this

How to Browse component?
Move cursor over a component to highlight it. The component highlighted by cursor is at the lowest level of the bridge. Use **Left** or **Right** arrow keys to browse components in the same level. Use **Up** or **Down** arrow keys to browse components in one level up or down. You can also browse the component list window to highlight component.

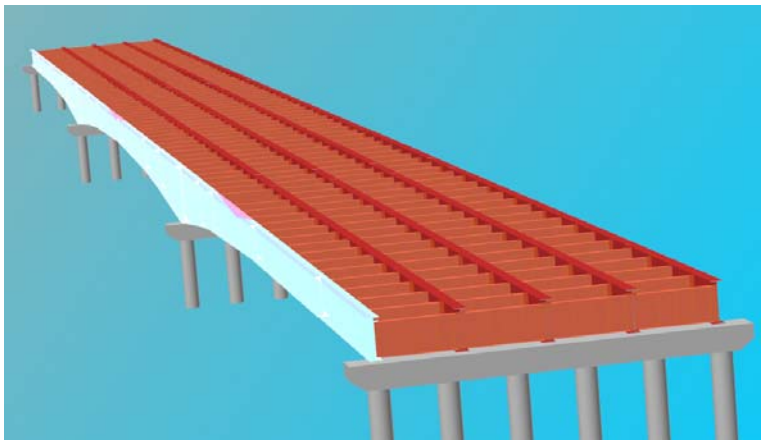
For example, a girder segment is highlighted as below:



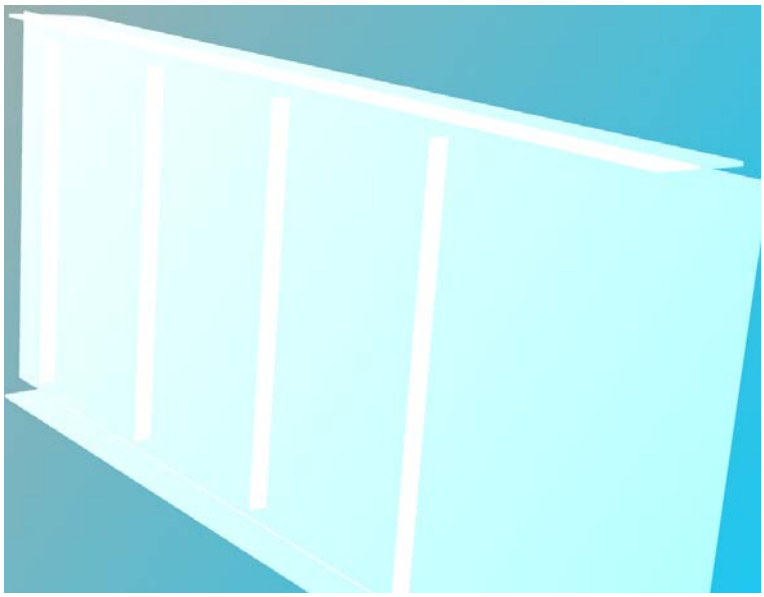
Press **Left** or **Right** key to move the highlighted component to other segments of the same girder as below.



Press **Up** key to move to one level up to the whole girder as shown below.



A component (diaphragm) is highlighted as below.



Press **Down** key to move the current component down to the first sub-component (of the diaphragm) as shown below.

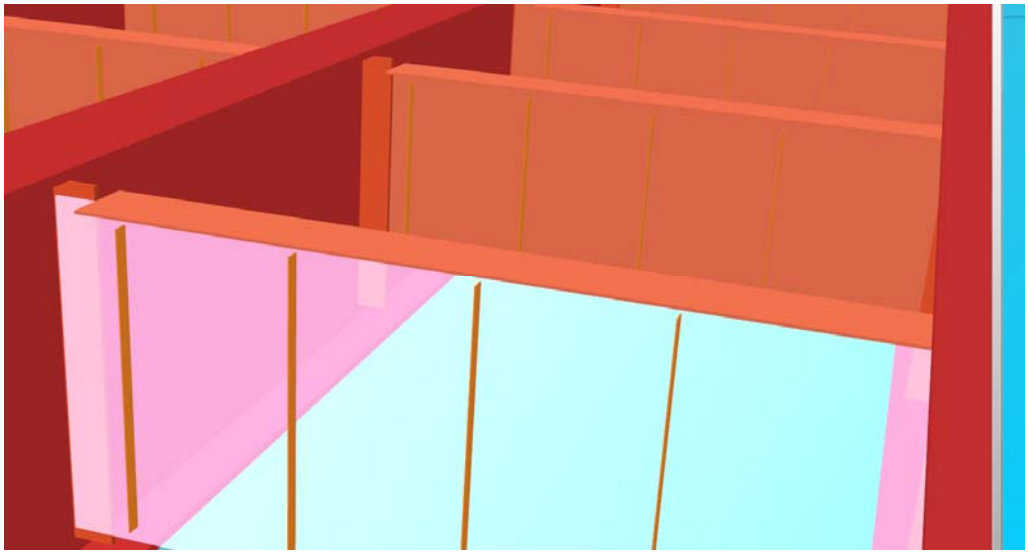
About **Rotation Center**
When holding **Left Button** and moving the cursor, the view will be changed as the bridge is being rotated. This is implemented by a **Tracking Ball**. Turning the bridge is as moving on the sphere on the ball. The center of the tracking ball is called the rotation center, which is automatically set to the center of the bridge by default.

When a simple component that is far away from the center of the bridge is highlighted, the rotation center should be set to the center of the highlight component. Rotation of that component will be abruptly if otherwise. When **Auto Rotation Center** is check in Bridge options, the rotation center will be updated automatically whenever the highlight component is changed.

When a simple component is highlighted as shown in above (and the rotation center is set to the center of the diaphragm), if you want to rotate the whole bridge along this center, you need to uncheck **Auto Rotation Center** before pressing F3 to toggle the scene back to showing all components. Then turning afterwards will be along the center of the simple component instead of the whole bridge.

Click **Update Rotation Center** to get the rotation center back to the center of whatever components are showing in the scene.

The following capture shows a bridge being rotated along the center of a diaphragm.



5.0 RUN UTILITY

The Run Utility of ***WIN-DASH*** performs calculations based on the choice entered in the PROGRAM FLOW CONTROL field found in data type 01032. The Run Utility allows single run and multiple run. By clicking on 'Run' a submenu with the options '**Single Run**' and '**Multiple Run**' appears. The user can only select one DASH input data file to run and get one set of result and graphic files for the single run. After finishing the run, the print utility can view/print this result file (by default). For the multiple run, the user can select several existing DASH input data files from any directory to run and get their respectively sets of result and graphic files. In this case, the user can select the result file one at a time to view/print. Single execution screen is shown in Figure 5.1.

5.1 Single Run

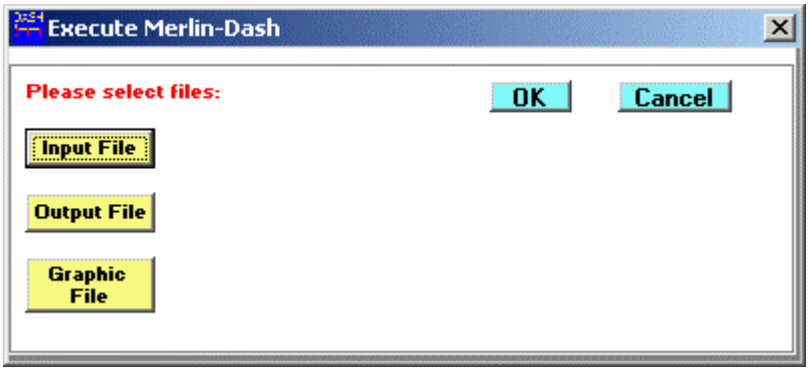


Figure 5.1: Run Utility Single Execution Screen

Clicking on the "Input File" button opens the "Input Data File" window which is shown in Figure 5.2. Choosing a file (highlighting the file) and then clicking "OK" will place the filename on the "Input File" button. This can also be accomplished by double clicking on the filename in the "Input Data File" window. After selecting the desired input file, clicking "OK" in the "RUN Utility" screen would execute ***WIN-DASH***. After the execution starts, a separate window will appear on the screen with program status shown.

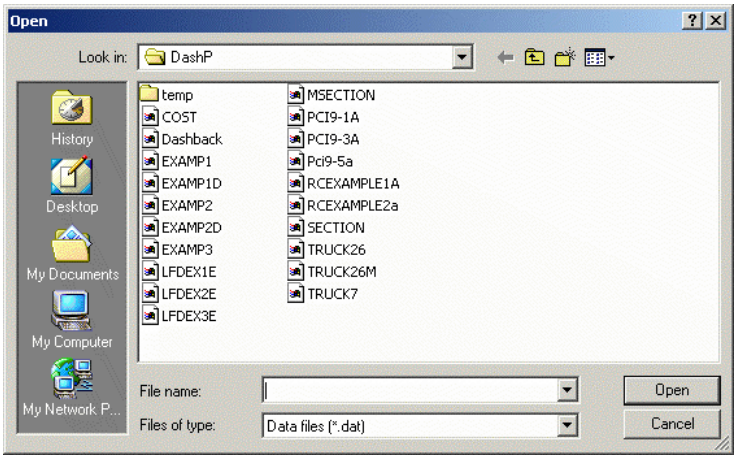


Figure 5.2: Input Data File Window

If *analysis* option -- Flow Control = 0, 1 ,7 or 8 -- is selected, only Part I - Analysis status window will be shown. If *code check* option -- Flow Control = 6 -- is chosen, Part II - Code Check window will appear following Part I. If *Rating* -- Flow Control = 3 -- is required, Part III-Rating window will then follow.

The default "Output File" and "Graphic File" will have same names as the selected Input file with different extensions. Output file has a .RES extension and Graphic file has a .GRH extension. User can click on either button to choose different names for output file or graphic file, respectively.

"Cancel" button on the "RUN" utility screen returns the user to the main menu.

5.2 Multiple Run

Clicking on "multiple run" submenu opens multiple run screen, which is shown in Figure 5.3. Pressing on the "Select Input Files" button opens the "Input Data File" window which is shown in Figure 5.2. Choosing a file (highlighting the file) and then clicking "OK" will place the file on the list at the bottom of the screen. To delete a file from the list, click on the file. After selecting all the desired input files, clicking "OK" in the "RUN Utility" screen would execute ***WIN-DASH***. An output file (.res) and a graphic file (.grh) with the same file name as the input data file will be generated after each run.

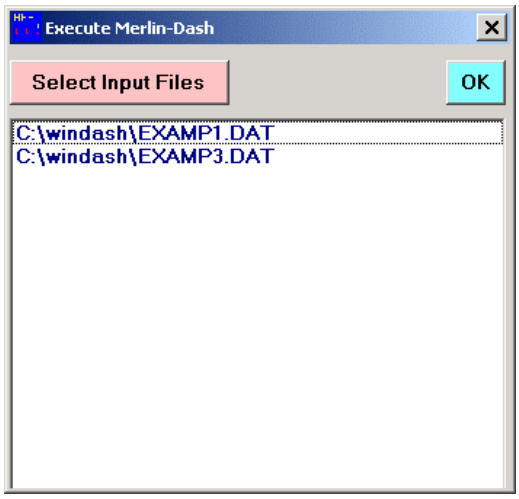


Figure 5.3: Run Utility Multiple Executions Screen

5.3 Single/Multiple Run Exit

After each execution ends, a pop-up window will appear on the screen with message “Program Terminated with exit code 0. Exit Window? “ Exit code 0 is a normal exit of the computation, click Yes to exit the “RUN” utility. Exit code 1 is an abnormal exit. Check input and output files for the cause of termination.

Figure 5.4: Program Terminated with Normal Exit Window

6.0 GRAPHICS UTILITY

The Graphics Utility of ***WIN-DASH*** is accessed by clicking on the word '**Graphic**' shown in the menu bar of the MAIN MENU screen. This transfers you to the ***WIN-DASH*** Graphics Utility screen. The Graphics Utility of ***WIN-DASH*** creates plots from the graphics files produced by the Run Utility. It allows you to open any graphics file created by ***WIN-DASH,*** view any of the graphics plots within that file, or print those plots using the Print option under the File Menu. Figure 6.1 shown below is the graphic plot menu options for the Steel.

Figure 6.1: Graphics Utility Screen (for Steel)

6.1 File Submenu

The File submenu which is shown in Figure 6.2, can be accessed by clicking on 'File' in the Graphic Utility screen. The available options are 'Open', 'Print Setup', 'Print', and 'Exit'.

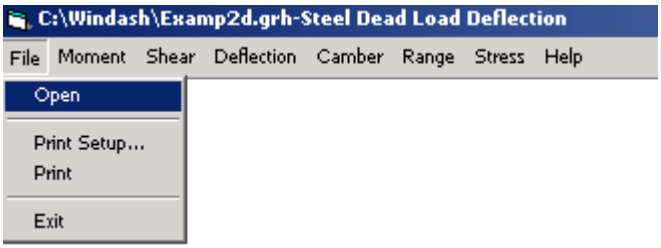


Figure 6.2: File Submenu

OPEN

Choosing 'Open' from the File submenu brings up the Open Graphic File window (Figure 6.3). This window allows the user to type in the name of the graphics file you wish to open, or to select the name of the file in the file name box. The file name box contains all the graphics files (*.grh) present in your ***WIN-DASH*** directory. By clicking on the directory icons on the right you can search other directories for graphics files. ***WIN-DASH*** allows the user to open graphics files created only by the ***WIN-DASH*** "Run" utility. If you open a file not created by the ***WIN-DASH*** "Run" utility and then try to produce a plot, an error message will occur. Only one graphics file can be opened at a time. If a second file is opened the first one will automatically be closed.

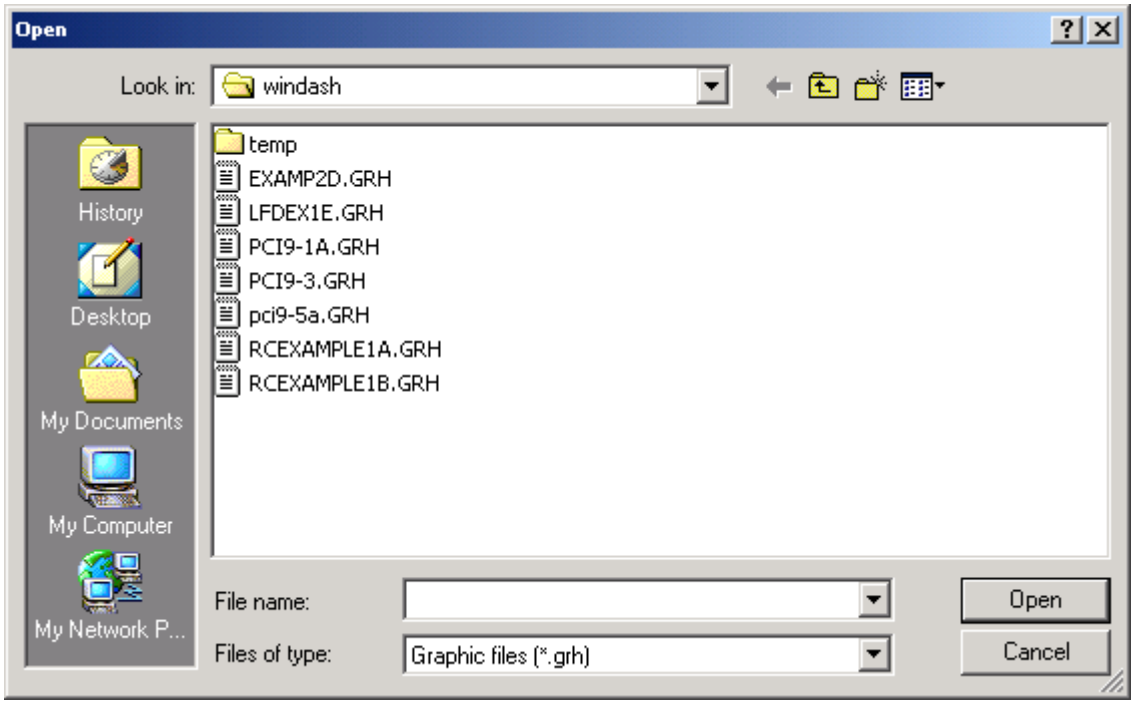


Figure 6.3: Open Graphic File Window

PRINT SETUP

Choosing 'Print Setup' from the File submenu allows the user to change the printer setup.

PRINT

Choosing 'Print' from the File submenu sends the currently displayed plot to the printer. Using the Print option is the only way to print out graphics plots produced by ***WIN-DASH.*** The Print Utility discussed later cannot be used to print graphics plots; it is used exclusively for printing Result Files.

EXIT

Choosing 'Exit' from the File submenu closes the graphics file (if one is opened) and brings you back to the ***WIN-DASH*** Main Menu.

6.2 Graphic Plots (for Steel)

Six options are available in ***WIN-DASH.*** They are Moment, Shear, Deflection, Camber, Stress Range, and Stress diagrams which are listed in Table 6.1. When a plot is displayed, the value at any given point can be determined by clicking on that point. An arrow will appear on the screen at the location of the chosen point. The 'Location' box in the upper left portion of the screen gives the distance from the left end of the first span to the chosen point, in the appropriate units. The unit, feet or meters, is determined by the unit system chosen on the input screen shown in Figure 4.7. The 'Value' box gives the magnitude of the quantity plotted, at the chosen point. Its units are also dependent upon whether the U.S. Customary or S.I. unit system was chosen on the same input screen.

Table 6.1: Graphic Plot Options

OPTIONS	**SUB-CTEGORIES**
MOMENT	Non-composite Dead Load Moment Superimposed Dead Load Moment Live Load Moment – Positive Live Load Moment – Negative Total Maximum moment Total minimum Moment
SHEAR	Non-composite Dead Load Shear Superimposed Dead Load Shear Live Load Shear – Positive Live Load Shear – Negative Total Maximum Shear Total Minimum Shear
DEFLECTION	Steel Dead Load Deflection Slab Dead Load Deflection Superimposed Dead Load Deflection Total Dead Load Deflection

Table 6.1: Graphic Plot Options (continued)

CAMBER	Steel Dead Load Camber Slab Dead Load Camber Superimposed Dead Load Camber Total Dead Load Camber
RANGE (Stress)	Stress Range – Top Flange Stress Range – Bottom Flange
STRESS	Top Flange Steel Dead Load Stress Slab Dead Load Stress Superimposed Dead Load Stress Maximum Total Positive and Allowable Stress Maximum Total Negative and Allowable Stress Total Positive Live Load Stress Total Negative Live Load Stress Allowable Stress Bottom Flange Steel Dead Load Stress Slab Dead Load Stress Superimposed Dead Load Stress Maximum Total Positive and Allowable Stress Maximum Total Negative and Allowable Stress Total Positive Live Load Stress Total Negative Live Load Stress Allowable Stress

6.2.1 Moment Diagrams (for Steel)

Moment submenu and a sample diagram are shown in Figures 6.4 and 6.5, respectively.

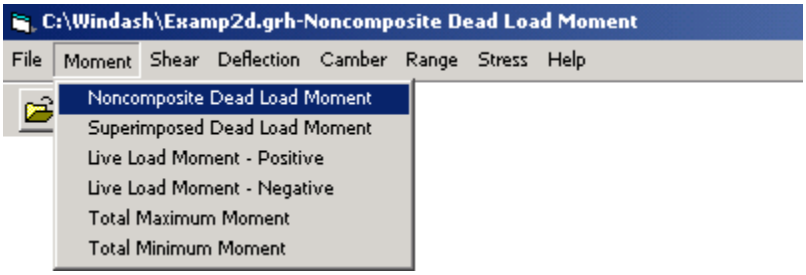


Figure 6.4: Moment Diagram Submenu

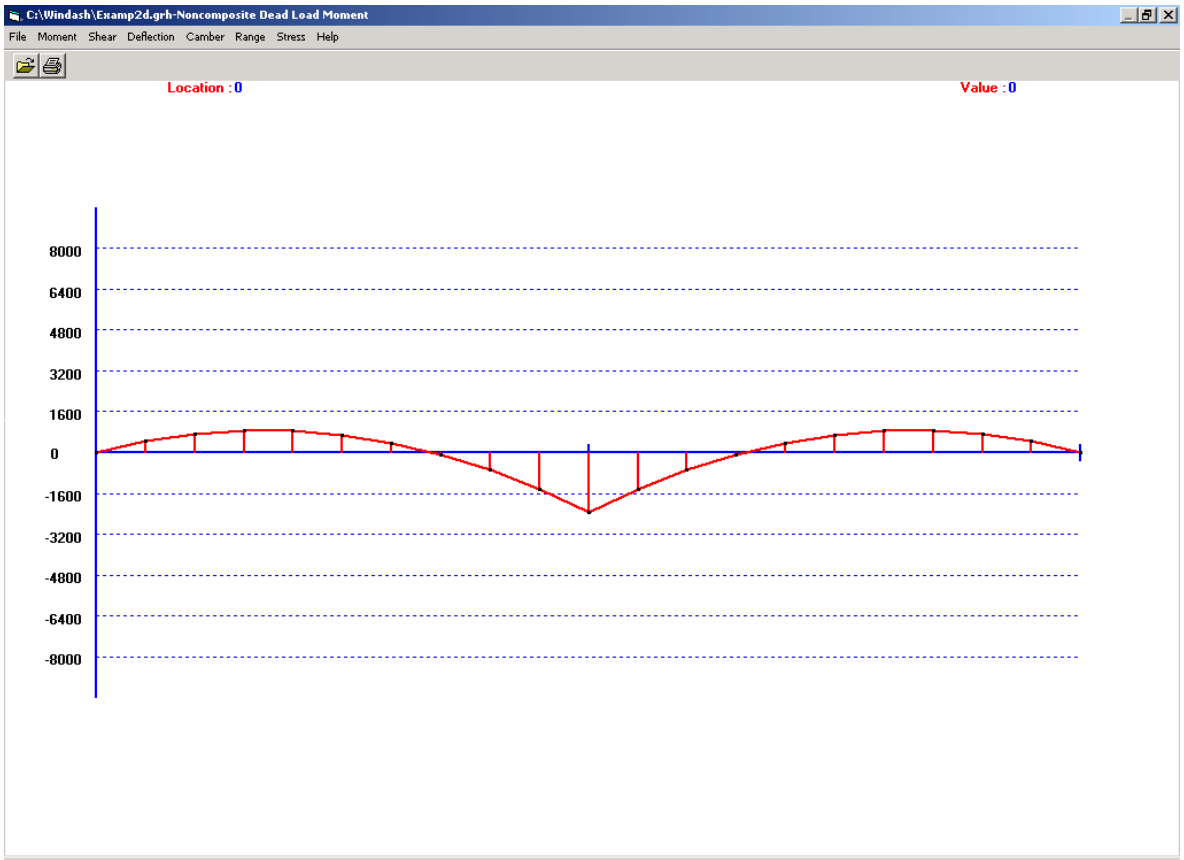


Figure 6.5: Noncomposite Dead Load Moment Diagram Screen

6.2.2 Shear Diagrams (for Steel)

Shear submenu and a sample diagram are shown in Figures 6.6 and 6.7, respectively.

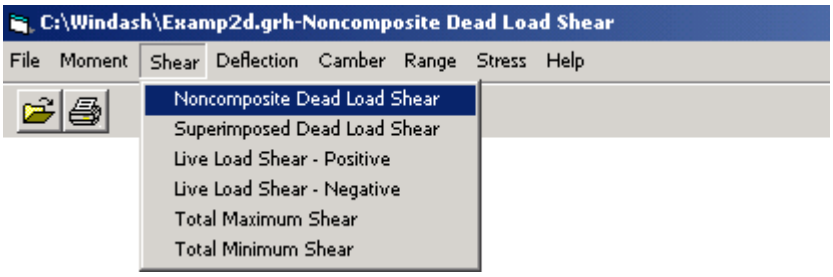


Figure 6.6: Shear Diagram Submenu

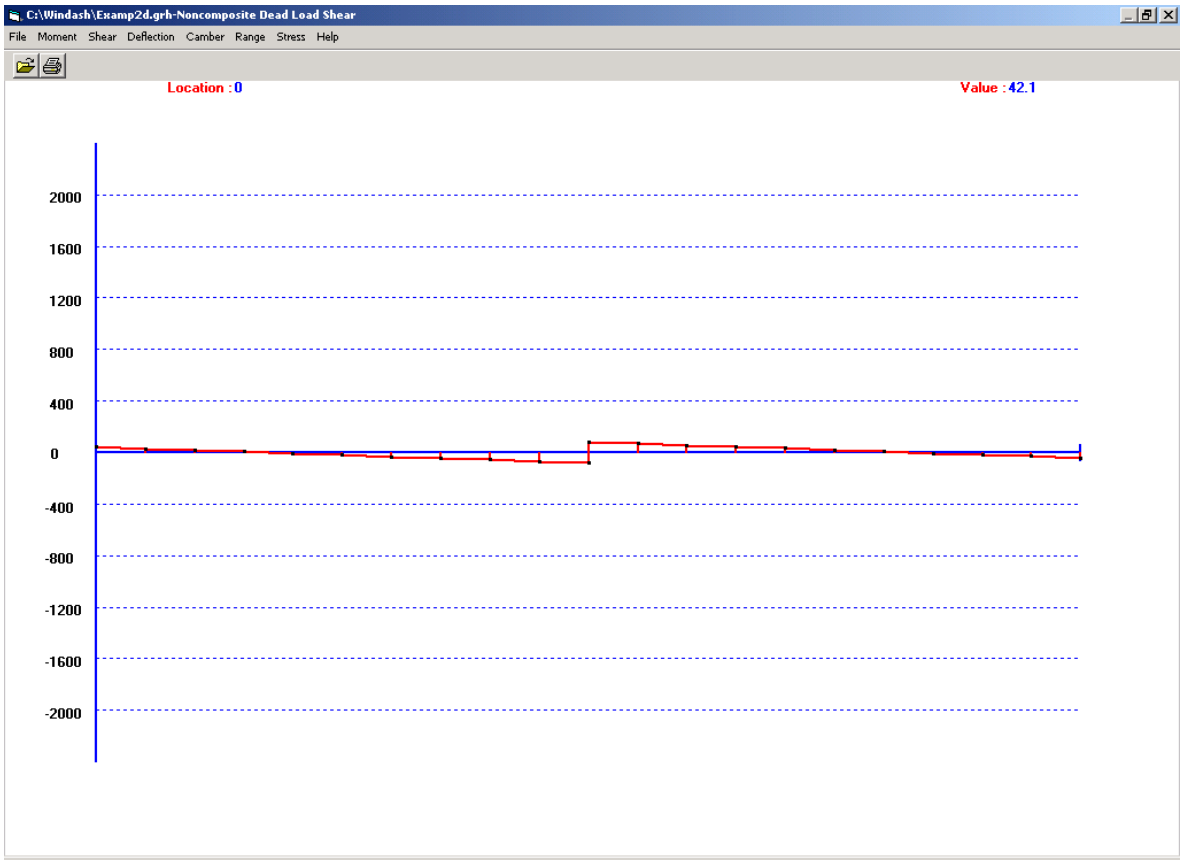


Figure 6.7: Noncomposite Dead Load Shear Diagram Screen

6.2.3 Deflection Diagrams (for Steel)

Deflection submenu and a sample diagram are shown in Figures 6.8 and 6.9, respectively.

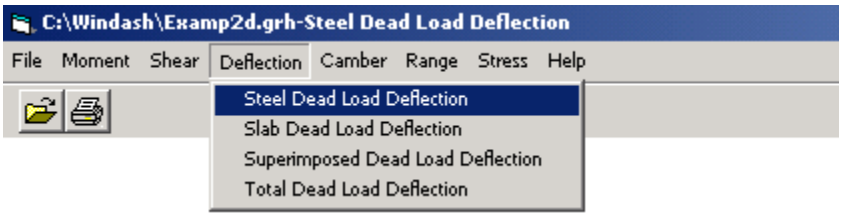


Figure 6.8 Deflection Diagrams Submenu

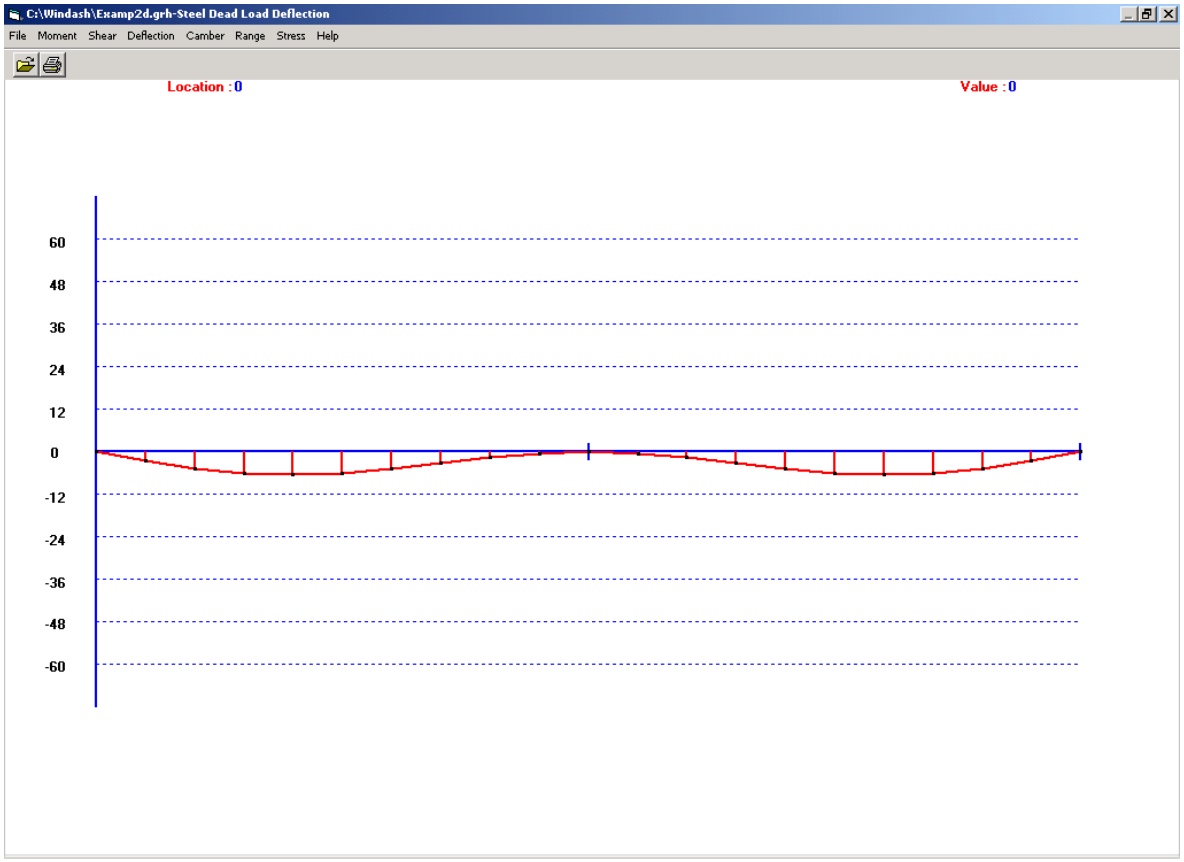


Figure 6.9: Steel Dead Load Deflection Diagram Screen

6.2.4 Camber Diagrams (for Steel)

Camber submenu and a sample diagram are shown in Figures 6.10 and 6.11, respectively.

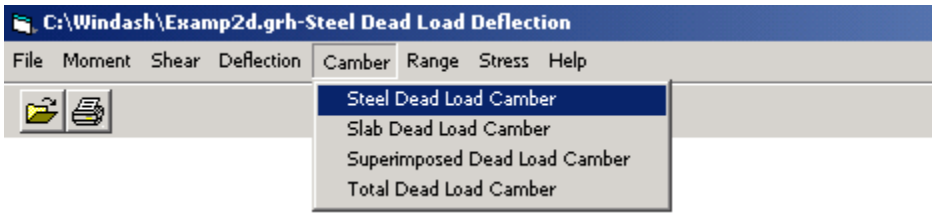


Figure 6.10: Camber Diagram Submenu

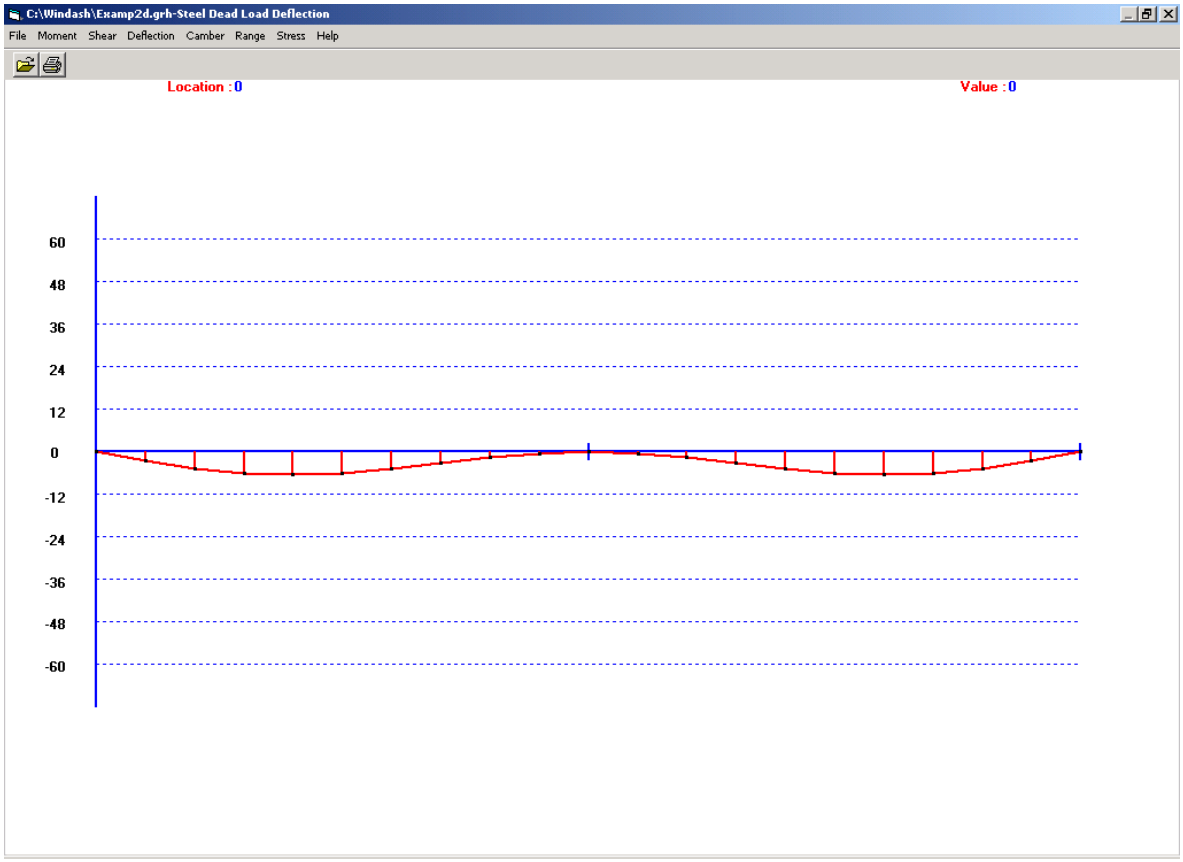


Figure 6.11: Steel Dead Load Camber Diagram Screen

6.2.5 Range (Stress) Diagrams (for Steel)

Range submenu and a sample diagram are shown in Figures 6.12 and 6.13, respectively.

Figure 6.12: Range (stress) Submenu

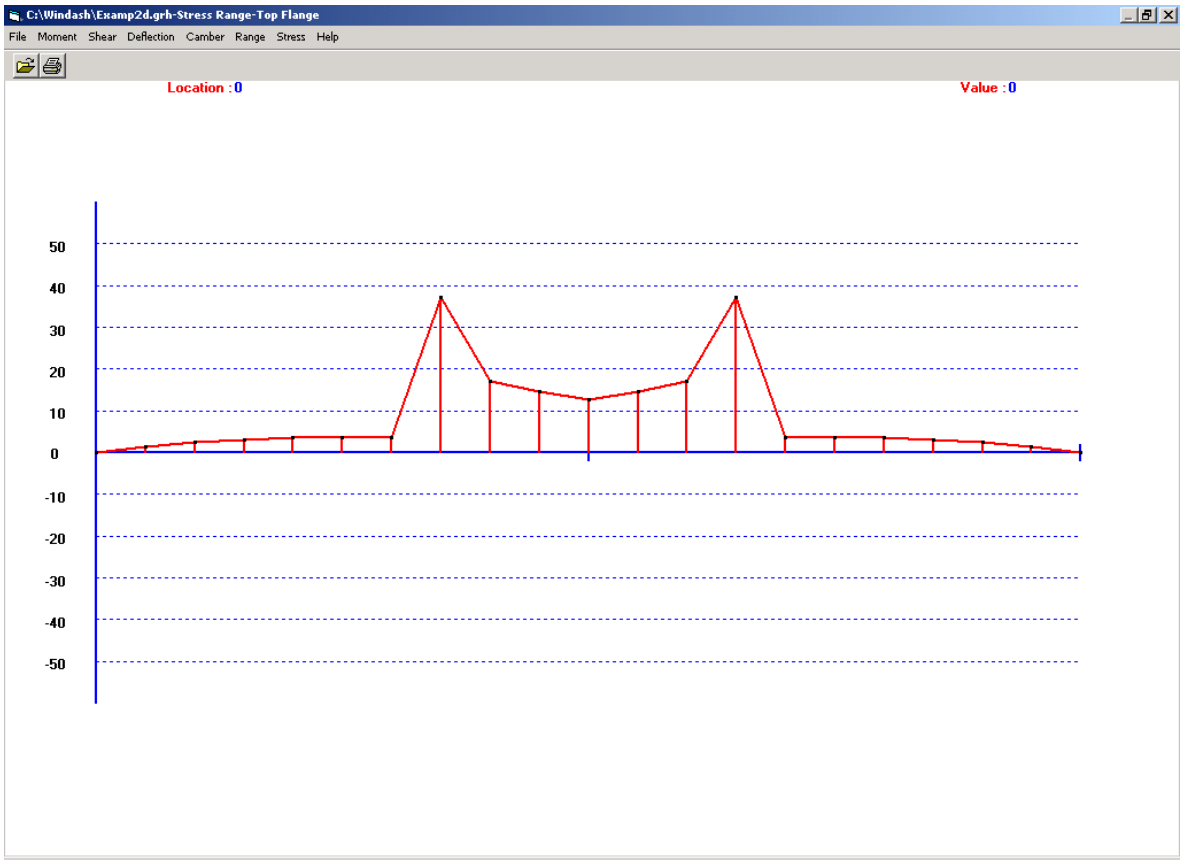


Figure 6.13: Top Flange Stress Range Diagram Screen

6.2.6 Stress Diagrams (for Steel)

6.2.6.1 Top Flange Stress Diagrams

Top Flange Stress submenu and a sample diagram are shown in Figures 6.14 and 6.15, respectively.

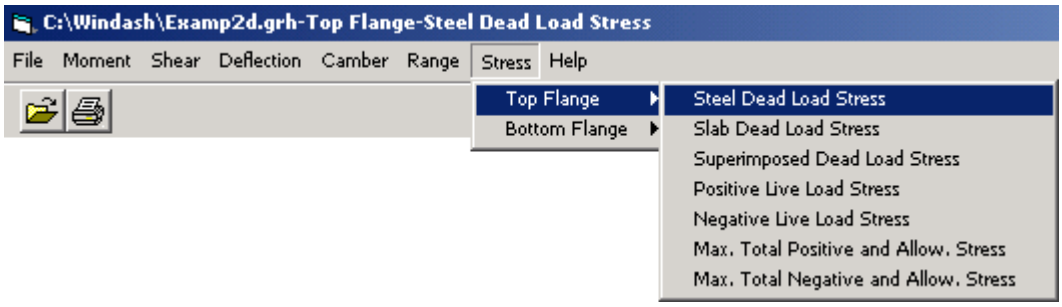


Figure 6.14: Top Flange Stress Submenu

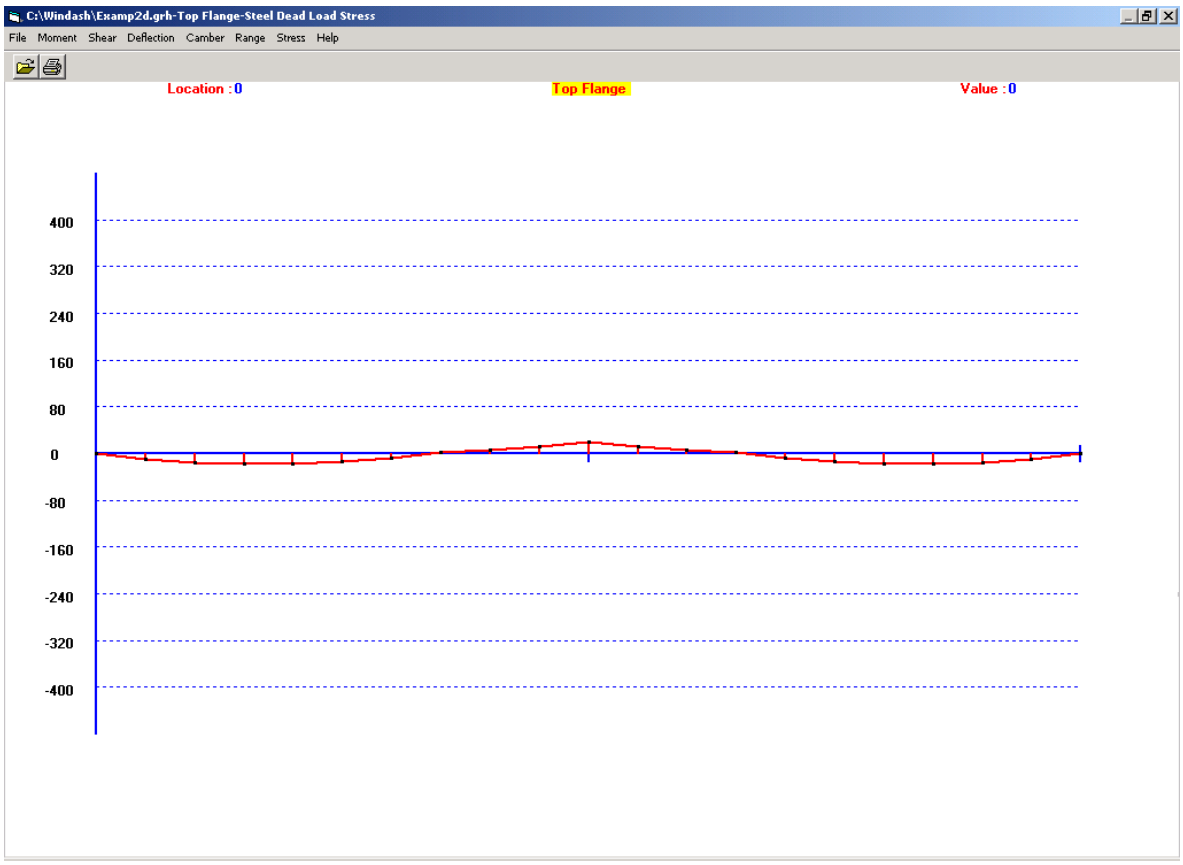


Figure 6.15: Top Flange Steel Dead Load Stress Diagram Screen

6.2.6.2 Bottom Flange Stress Diagrams

Bottom Flange Stress submenu and a sample diagram are shown in Figures 6.16 and 6.17, respectively.

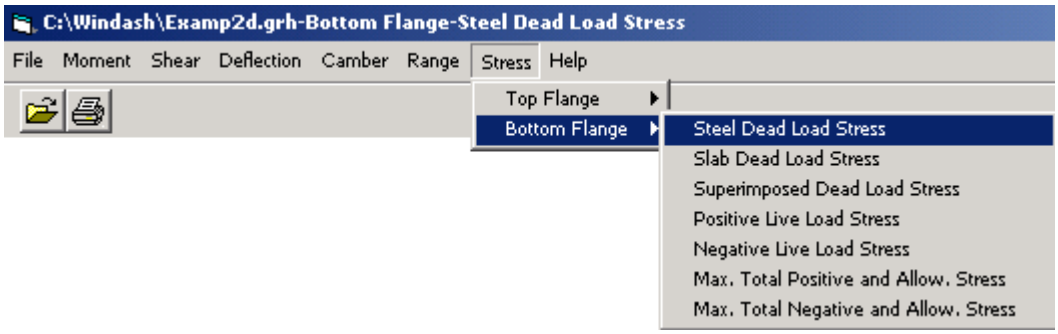


Figure 6.16: Bottom Flange Stress Submenu

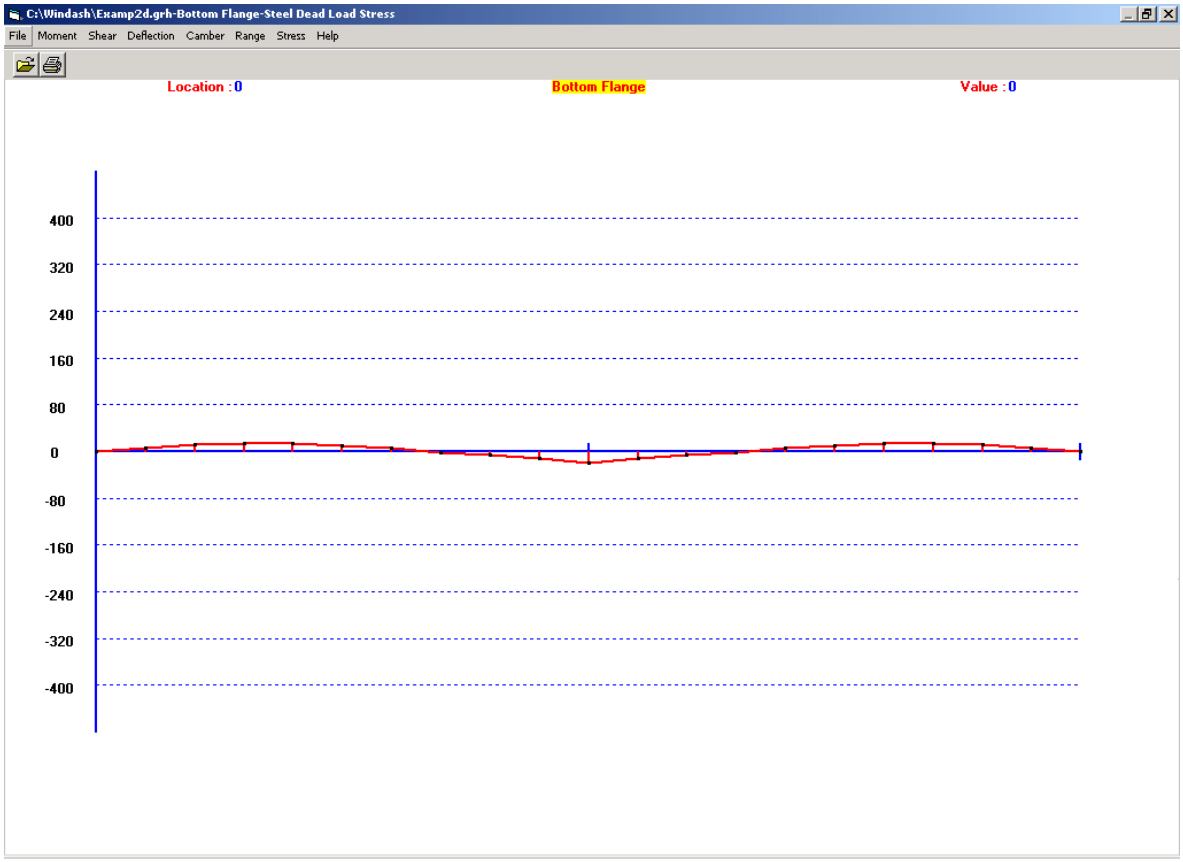


Figure 6.17: Bottom Flange Steel Dead Load Stress Diagram Screen

6.3 Graphic Plots (for Prestressed Concrete)

Six options for Prestressed Concrete are available in ***WIN-DASH.*** They are Moment, Shear, Displacement, Bottom Stress, Top Stress, and Slab Top Stress diagrams which are listed in Table 6.2. When a plot is displayed, the value at any given point can be determined by clicking on that point. An arrow will appear on the screen at the location of the chosen point. The 'Location' box in the upper left portion of the screen gives the distance from the left end of the first span to the chosen point, in the appropriate units. The unit, feet or meters, is determined by the unit system chosen on the input screen shown in Figure 4.7. The 'Value' box gives the magnitude of the quantity plotted, at the chosen point. Its units are also dependent upon whether the U.S. Customary or S.I. unit system was chosen on the same input screen.

Table 6.2: Graphic Plot Options

OPTIONS	**SUB-CATEGORIES**
MOMENT	Girder Wt. Moment Slab Wt. Moment SDL Moment LL + (Positive LL) Moment LL – (Negative LL) Moment Total Maximum Moment Capacity Total Minimum Moment Capacity
SHEAR	Girder Wt. Shear Slab Wt. Shear SDL Shear LL + (Positive LL) Shear LL – (Negative LL) Shear Total Minimum Shear
DISPLACEMENT	Girder Wt. Displacement Slab Wt. Displacement

(continued)

Table 6.2: Graphic Plot Options (continued)

OPTIONS	SUB-CATEGORIES
DISPLACEMENT	SDL Displacement LL + (Positive LL) Displacement LL – (Negative LL) Displacement Initial Prestress Displacement Ultimate Prestress Displacement Total Maximum Displacement Total Minimum Displacement
BOTTOM STRESS	Girder Wt. Bottom Stress Slab Wt. Bottom Stress SDL Bottom Stress LL + (Positive LL) Bottom Stress LL – (Negative LL) Bottom Stress PSI Initial Prestress Bottom Stress PSU Ultimate Prestress Bottom Stress Total At Release and Allowable Bottom Stress Total Maximum and Allowable Bottom Stress Total Minimum and Allowable Bottom Stress
TOP STRESS	Girder Wt. Top Stress Slab Wt. Top Stress SDL Top Stress LL + (Positive LL) Top Stress LL – (Negative LL) Top Stress PSI Initial Prestress Top Stress

(continued)

Table 6.2: Graphic Plot Options (continued)

OPTIONS	**SUB-CATEGORIES**
	PSU Ultimate Prestress Top Stress Total At Release and Allowable Top Stress Total Maximum and Allowable Top Stress Total Minimum and Allowable Top Stress
SLAB TOP STRESS	SDL Slab Top Stress LL + (Positive LL) Slab Top Stress LL – (Negative LL) Slab Top Stress Total Maximum and Allowable Slab Top Stress Total Minimum and Allowable Slab Top Stress

6.3.1 Moment Diagrams (for Prestressed Concrete)

Moment submenu and a sample diagram are shown in Figures 6.18 and 6.19, respectively.

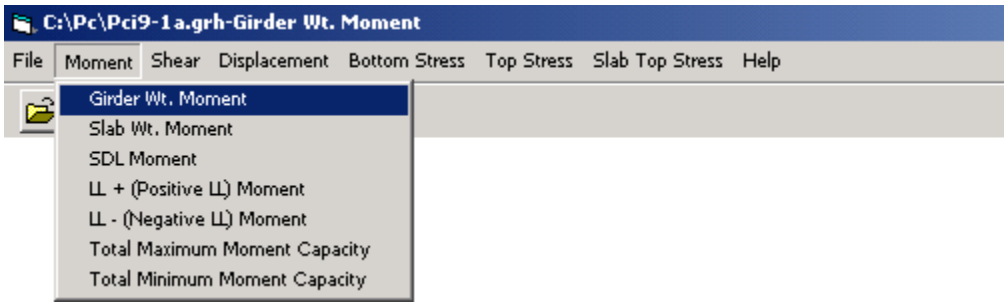


Figure 6.18: Moment Diagram Submenu (for Prestressed Concrete)

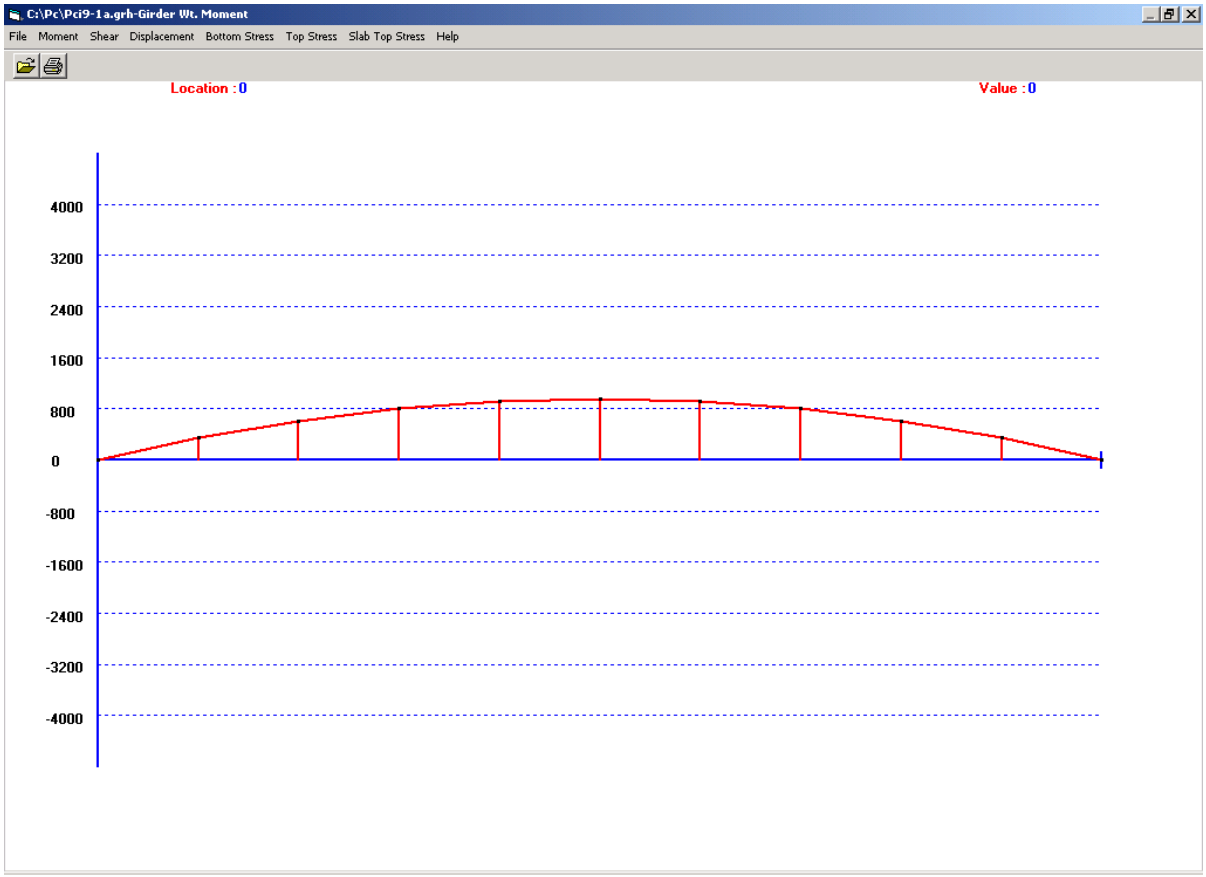


Figure 6.19: Girder Wt. Moment Diagram Screen

6.3.2 Shear Diagrams (for Prestressed Concrete)

Shear submenu and a sample diagram are shown in Figures 6.20 and 6.21, respectively.

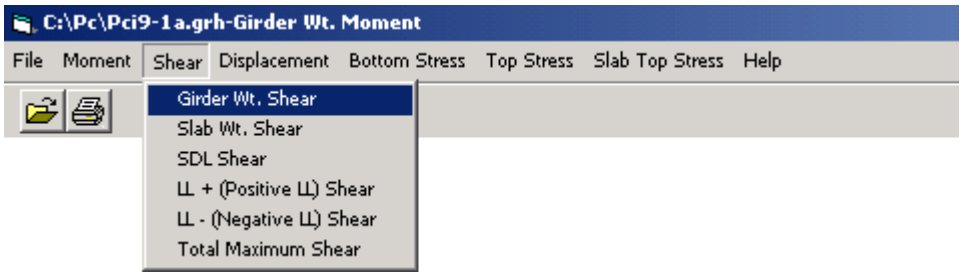


Figure 6.20: Shear Diagram Submenu (for Prestressed Concrete)

Figure 6.21: Girder Wt. Shear Diagram Screen (for Prestressed Concrete)

6.3.3 Displacement Diagrams (for Prestressed Concrete)

Displacement submenu and a sample diagram are shown in Figures 6.22 and 6.23, respectively.

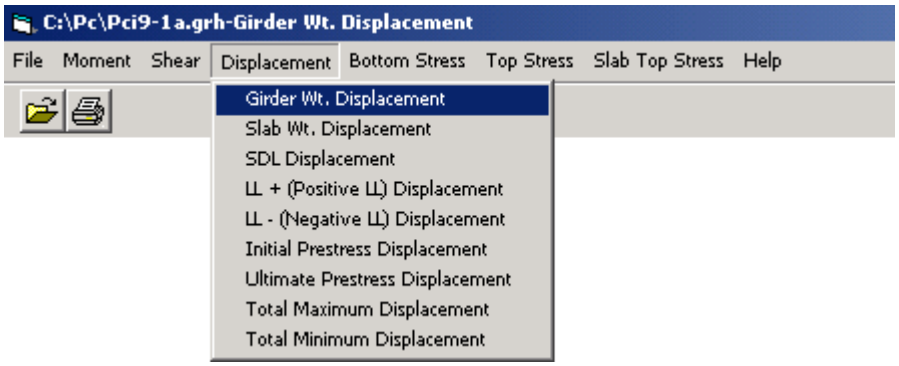


Figure 6.22: Displacement Diagram Submenu (for Prestressed Concrete)

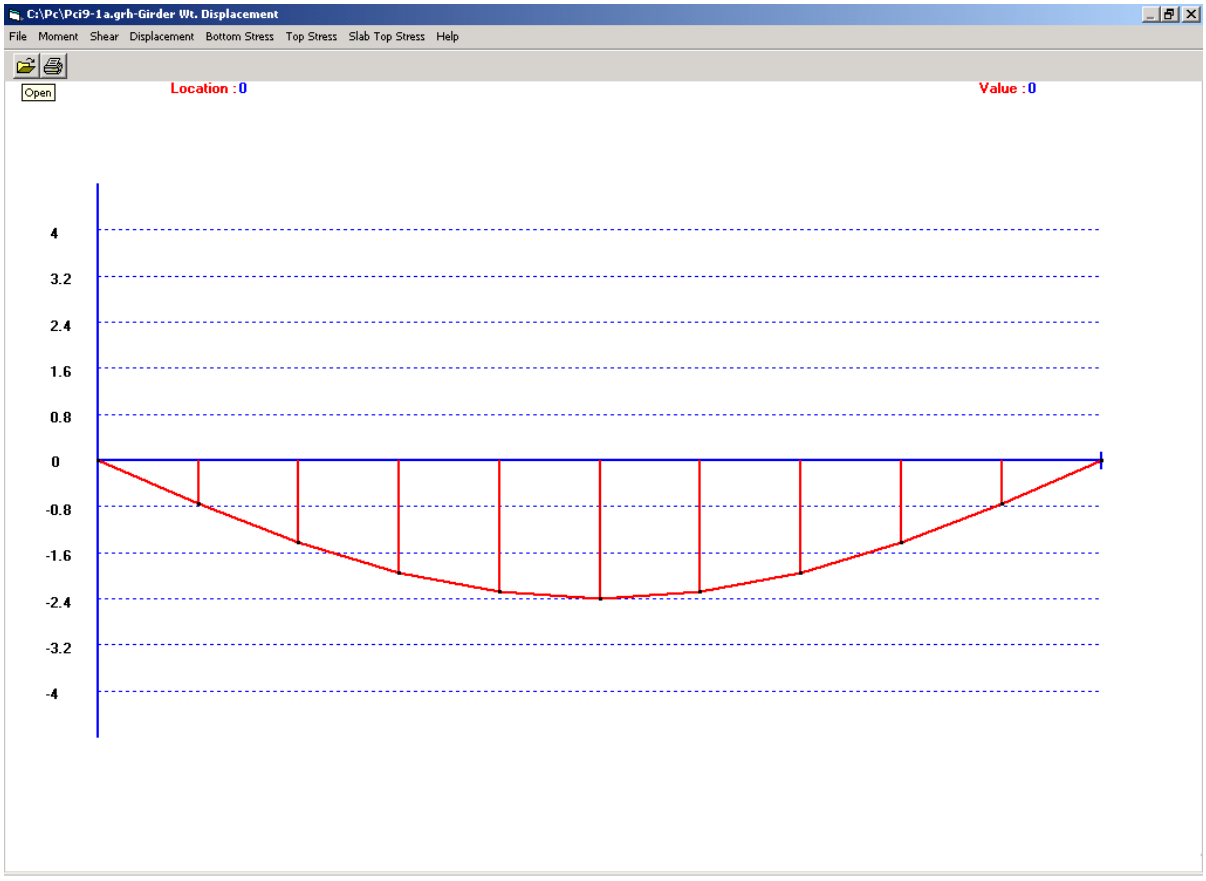


Figure 6.23: Girder Wt. Displacement Diagram Screen (for Prestressed Concrete)

6.3.4 Bottom Stress Diagrams (for Prestressed Concrete)

Bottom Stress submenu and a sample diagram are shown in Figures 6.24 and 6.25, respectively.

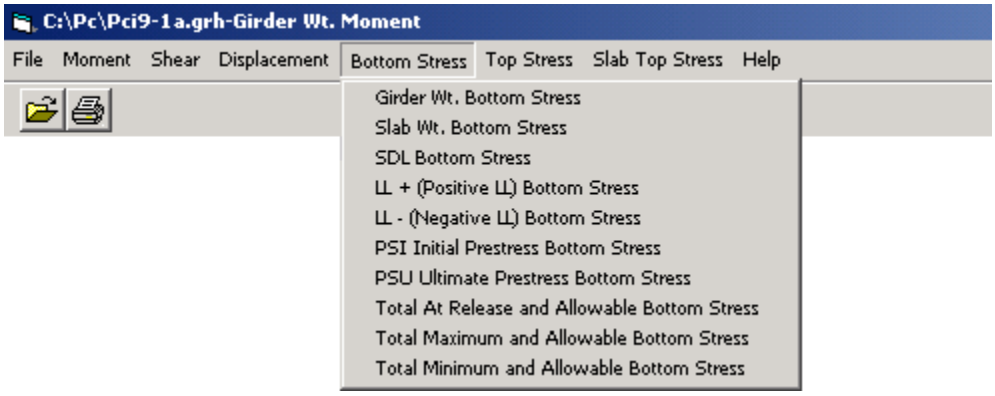


Figure 6.24: Bottom Stress Diagram Submenu (for Prestressed Concrete)

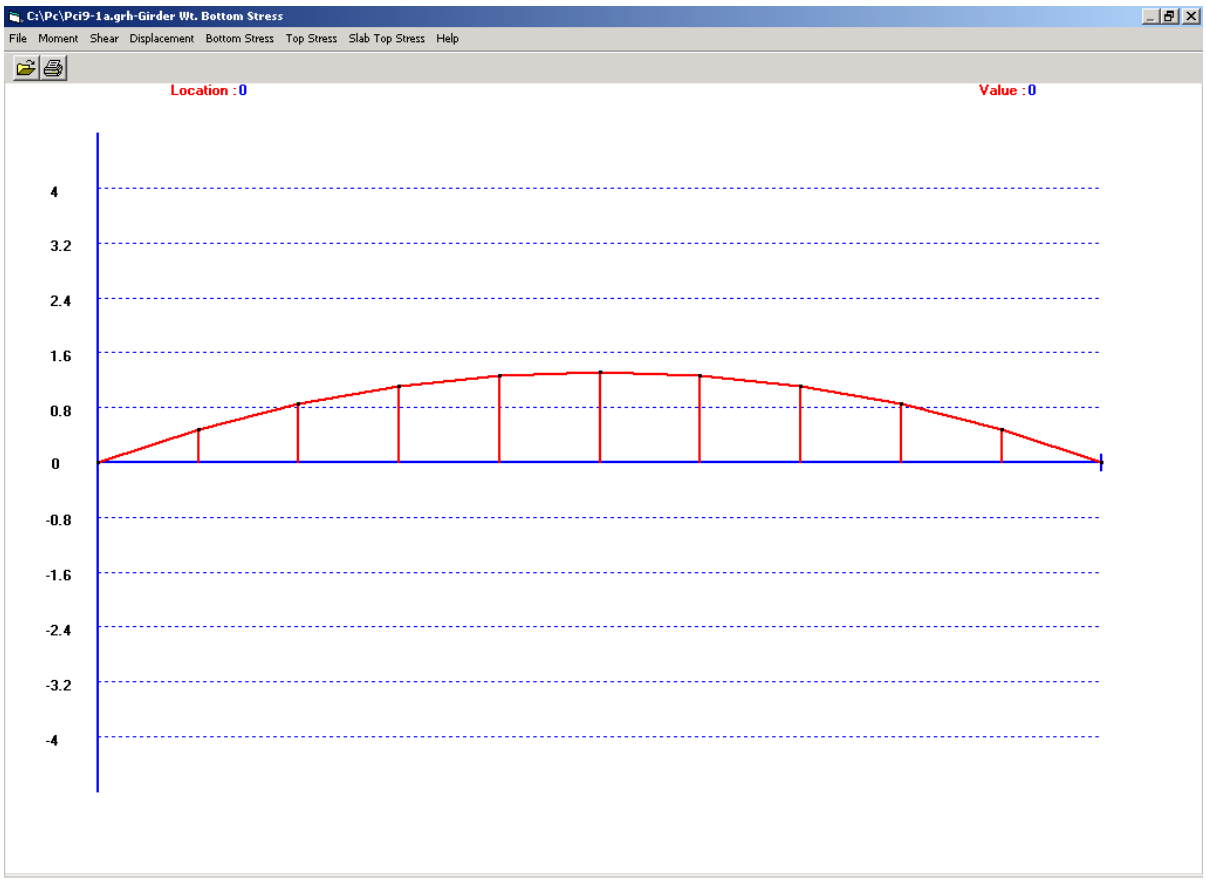


Figure 6.25: Girder Wt. Bottom Stress Diagram Screen (for Prestressed Concrete)

6.3.5 Top Stress Diagrams (for Prestressed Concrete)

Top Stress submenu and a sample diagram are shown in Figures 6.26 and 6.27, respectively.

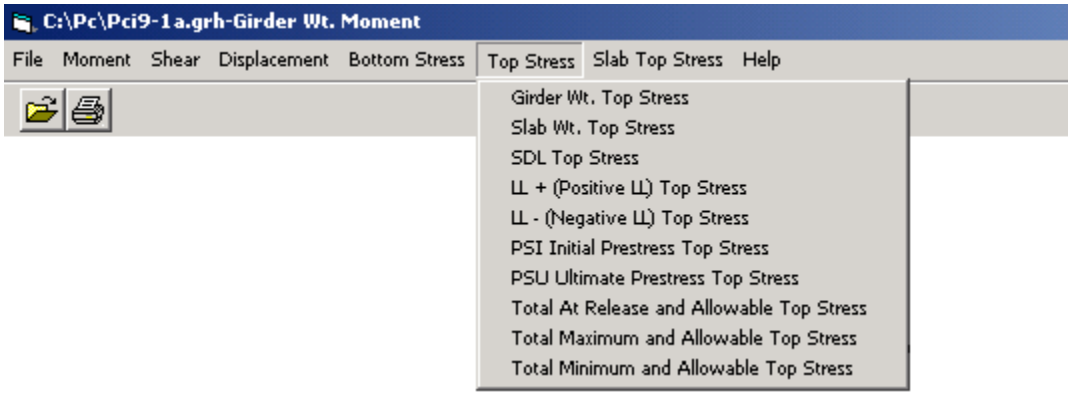


Figure 6.26: Top Stress Diagram Submenu (for Prestressed Concrete)

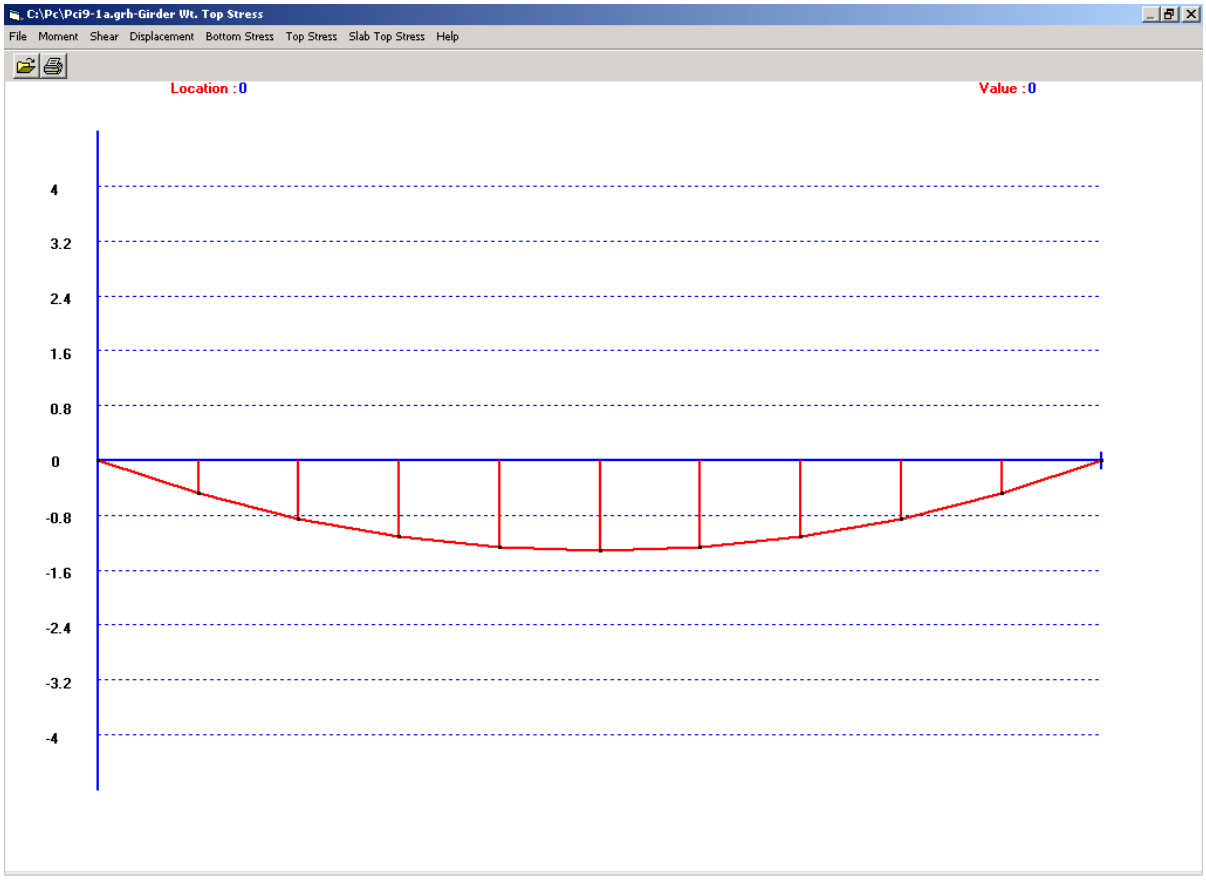


Figure 6.27: Girder Wt. Top Stress Diagram Screen (for Prestressed Concrete)

6.3.6 Slab Top Stress Diagrams (for Prestressed Concrete)

Slab Top Stress submenu and a sample diagram are shown in Figures 6.28 and 6.29, respectively.

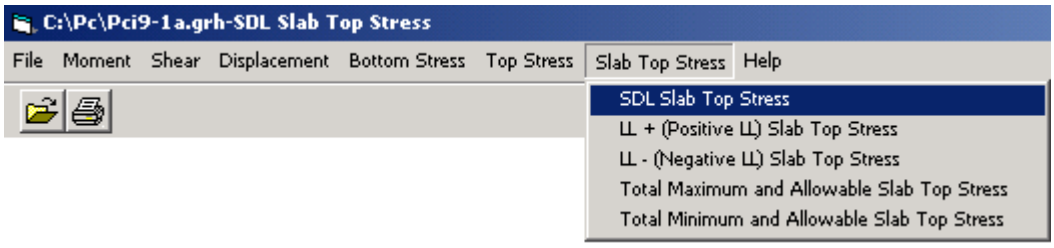


Figure 6.28: Slab Top Stress Diagram Submenu (for Prestressed Concrete)

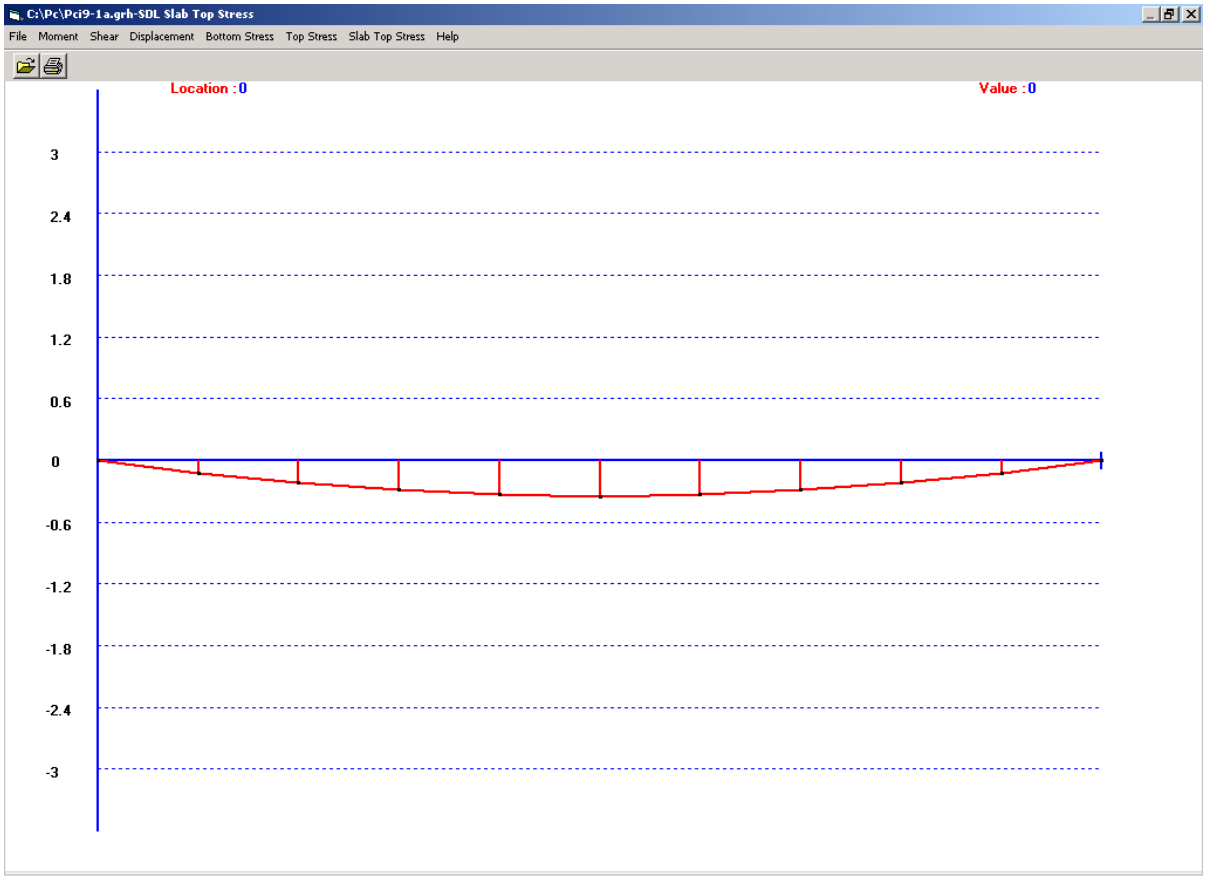


Figure 6.29: SDL Slab Top Stress Diagram Screen (for Prestressed Concrete)

7.0 PRINT UTILITY

The Print Utility of ***WIN-DASH*** is accessed by clicking on the word 'Print' shown in the menu bar of the MAIN MENU screen. This transfers you to the ***WIN-DASH*** Print Utility screen (Figure 7.1). The Print Utility performs the printing of the output files created by the Run Utility. It offers the user the ability to view the output before printing. The entire output file or selected tables can be printed from this utility. It is important to note that an output file must be opened first to use this utility.

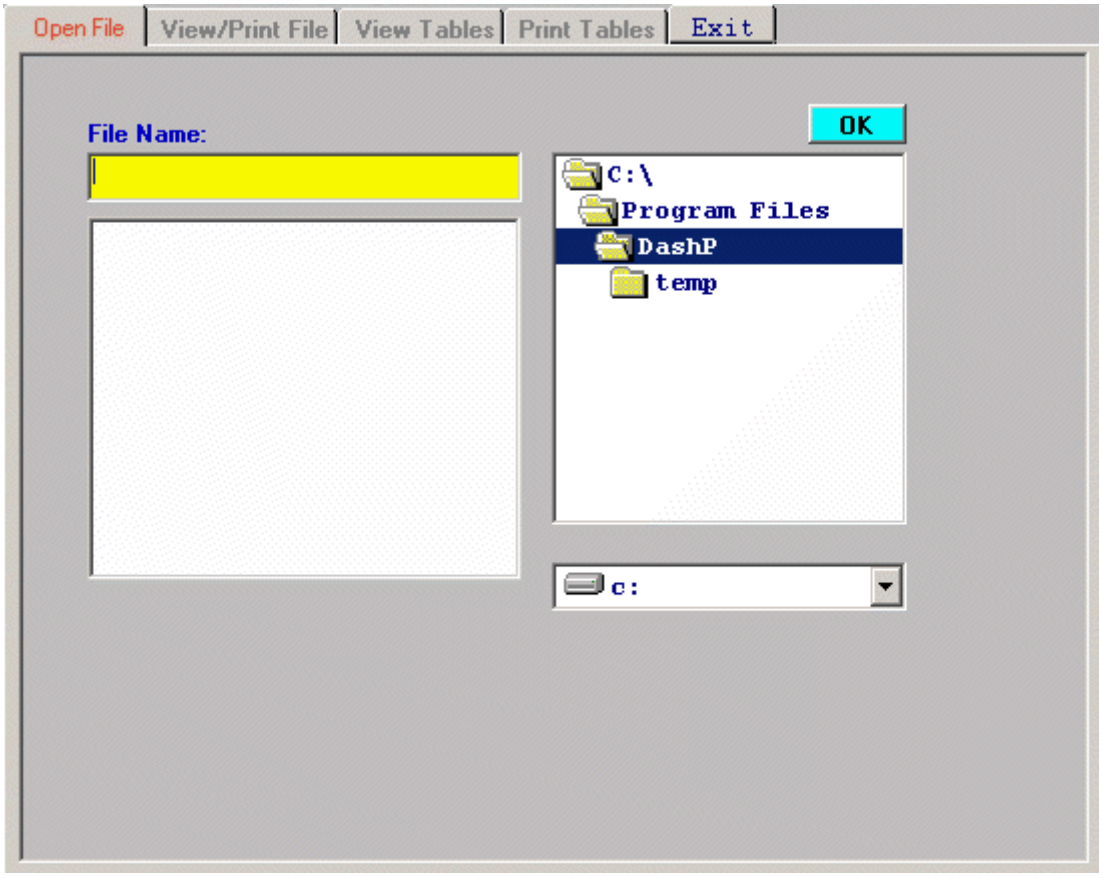


Figure 7.1 Print Utility Screen

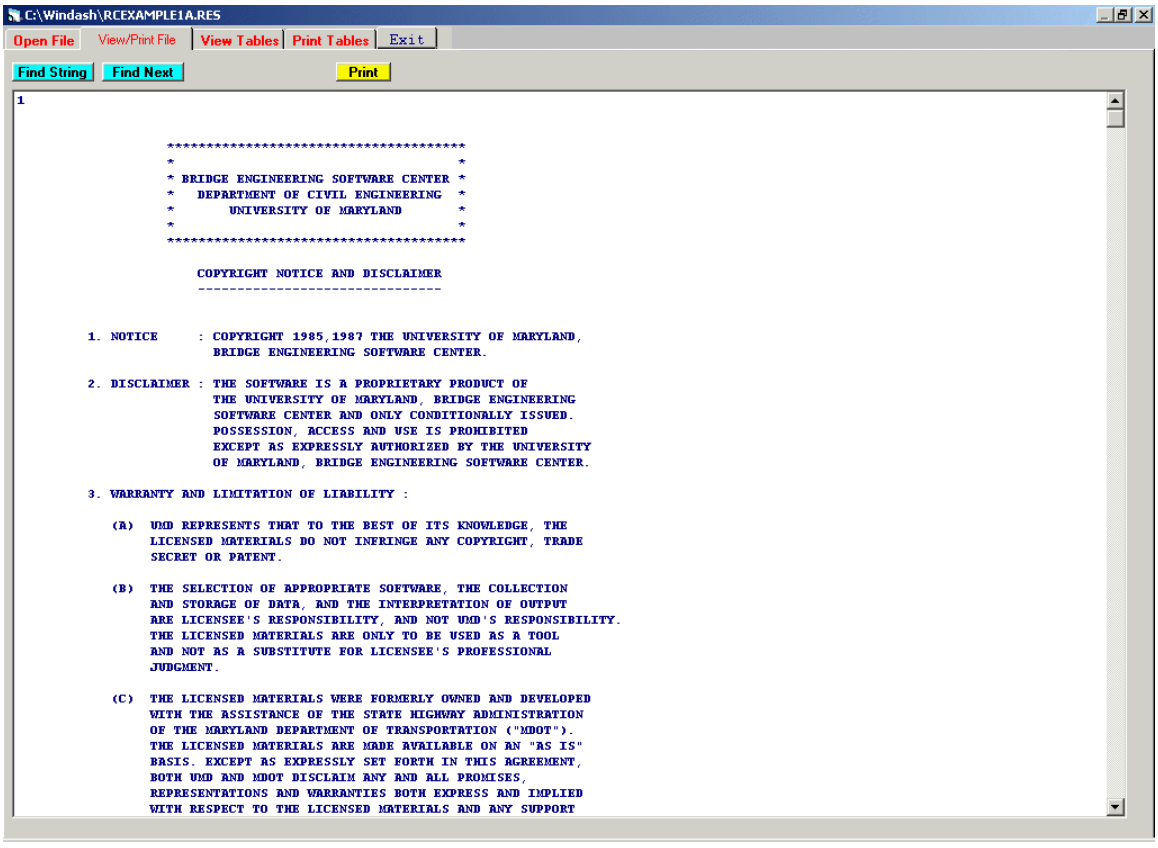
7.1 Open File

Print files previously saved under your WIN-DASH directory will appear in the larger box on the lower left side of the Open File screen. Double-clicking on the name of one of these files opens it. Print files saved in other directories or drives can be accessed by scrolling through the 'Directories' and/or the 'Drives' boxes. **All files to be opened must have the extension '.res'**.

Files may also be opened by typing or highlighting the name in the File Name box and then clicking on the OK button or hitting the ENTER key.

7.2 View/Print File

This option allows the user to review the results page by page in a continuous manner. A typical result file screen is given in Figure 7.2. This screen will be activated automatically after opening a file.


C:\Windash\RCEXAMPLE1A.RES
Open File
View/Print File
View Tables
Print Tables
Exit
Find String
Find Next
Print
1
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* DEPARTMENT OF CIVIL ENGINEERING *
* UNIVERSITY OF MARYLAND *
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Figure 7.2: A Typical Result File Screen

Clicking on the 'Print' button on the screen will bring up a window, which is shown in Figure 7.3. The options available are '**Print File with Form Feed**' and '**Print File without Form Feed**'.

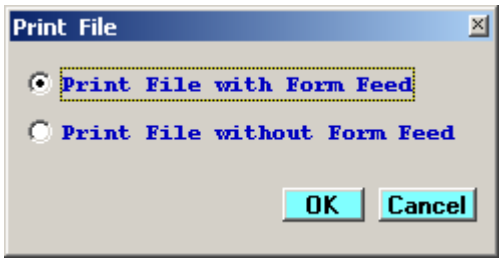


Figure 7.3: Print File Window

Clicking **'Find String'** button brings up a window, which is shown in Figure 7.4. This window allows the user to enter a string (a word or phrase), which he/she is trying to locate in the output file. After entering the string and choosing 'Ok', the program will locate the first occurrence of that string in the output file. Clicking the **'Find Next'** button then brings the next occurrence of the string

Figure 7.4: Search String Window

7.3 View Tables

Although the scroll bar lets the user move back and forth between the pages, one may find it time consuming if a specific table of results is desired for review. The View Table option serves this purpose. The top window contains the list of tables. Highlighting a table brings that table to the lower window. A typical View Table screen is presented in Figure 7.5.

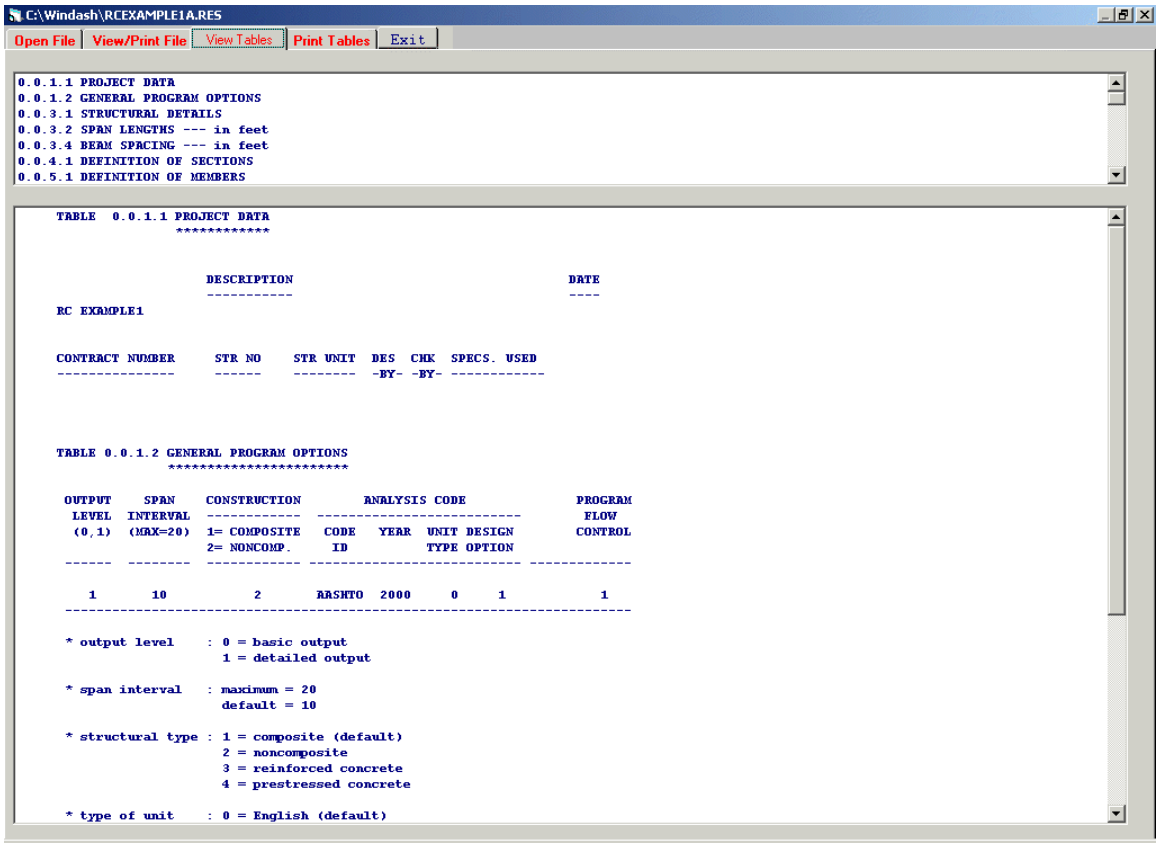


Figure 7.5: A Typical View Table Screen

7.4 Print Tables

The print tables screen will be shown after clicking on the 'Print Tables' tab. The bottom window contains the list of tables. Highlighting a table brings that table to the upper window (Table Selected). Click on the '**Print**' button, will send the table selected to a printer. A typical Print Tables screen is presented in Figure 7.6.

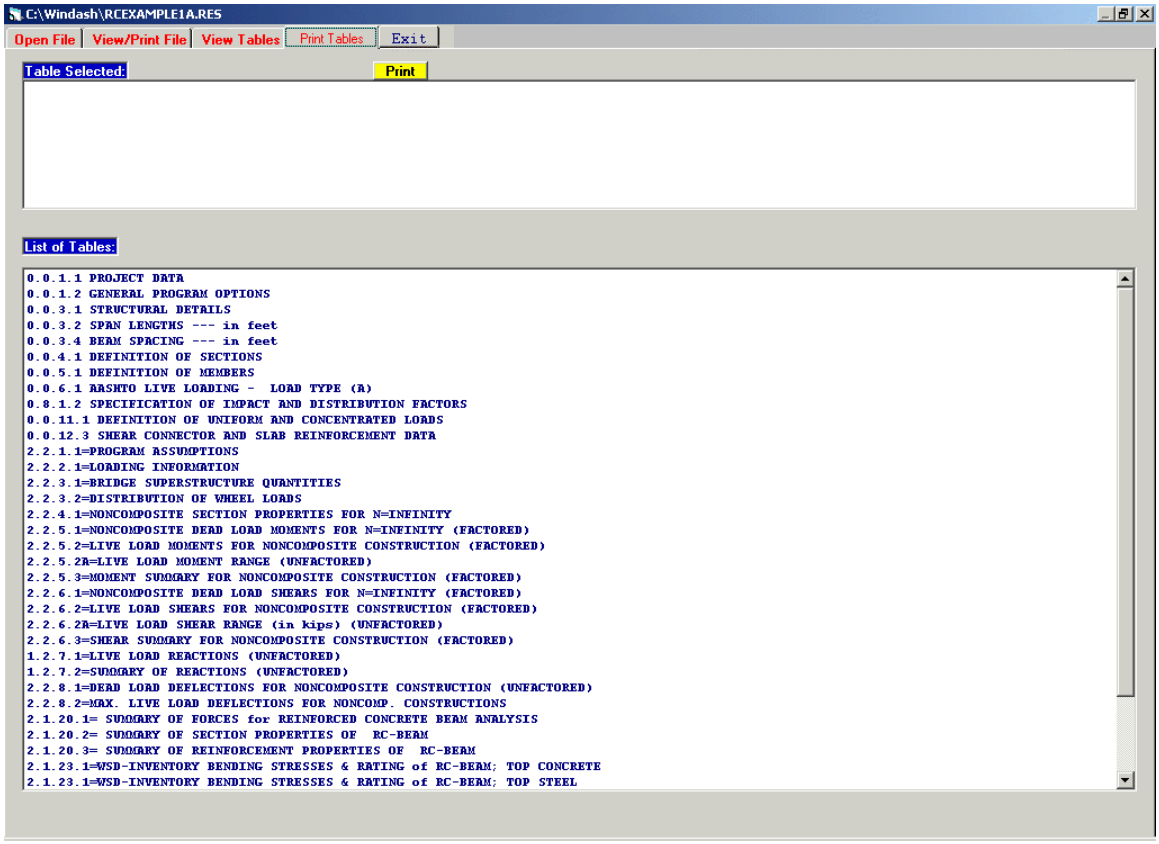

C:\Windash\RCEXAMPLE1A.RES
Open File
View/Print File
View Tables
Print Tables
Exit
Table Selected:
Print
List of Tables:
0.0.1.1 PROJECT DATA
0.0.1.2 GENERAL PROGRAM OPTIONS
0.0.3.1 STRUCTURAL DETAILS
0.0.3.2 SPAN LENGTHS --- in feet
0.0.3.4 BEAM SPACING --- in feet
0.0.4.1 DEFINITION OF SECTIONS
0.0.5.1 DEFINITION OF MEMBERS
0.0.6.1 AASHTO LIVE LOADING - LOAD TYPE (A)
0.8.1.2 SPECIFICATION OF IMPACT AND DISTRIBUTION FACTORS
0.0.11.1 DEFINITION OF UNIFORM AND CONCENTRATED LOADS
0.0.12.3 SHEAR CONNECTOR AND SLAB REINFORCEMENT DATA
2.2.1.1=PROGRAM ASSUMPTIONS
2.2.2.1=LOADING INFORMATION
2.2.3.1=BRIDGE SUPERSTRUCTURE QUANTITIES
2.2.3.2=DISTRIBUTION OF WHEEL LOADS
2.2.4.1=NONCOMPOSITE SECTION PROPERTIES FOR N=INFINITY
2.2.5.1=NONCOMPOSITE DEAD LOAD MOMENTS FOR N=INFINITY (FACTORED)
2.2.5.2=LIVE LOAD MOMENTS FOR NONCOMPOSITE CONSTRUCTION (FACTORED)
2.2.5.2A=LIVE LOAD MOMENT RANGE (UNFACTORED)
2.2.5.3=MOMENT SUMMARY FOR NONCOMPOSITE CONSTRUCTION (FACTORED)
2.2.6.1=NONCOMPOSITE DEAD LOAD SHEARS FOR N=INFINITY (FACTORED)
2.2.6.2=LIVE LOAD SHEARS FOR NONCOMPOSITE CONSTRUCTION (FACTORED)
2.2.6.2A=LIVE LOAD SHEAR RANGE (in kips) (UNFACTORED)
2.2.6.3=SHEAR SUMMARY FOR NONCOMPOSITE CONSTRUCTION (FACTORED)
1.2.7.1=LIVE LOAD REACTIONS (UNFACTORED)
1.2.7.2=SUMMARY OF REACTIONS (UNFACTORED)
2.2.8.1=DEAD LOAD DEFLECTIONS FOR NONCOMPOSITE CONSTRUCTION (UNFACTORED)
2.2.8.2=MAX. LIVE LOAD DEFLECTIONS FOR NONCOMP. CONSTRUCTIONS
2.1.20.1= SUMMARY OF FORCES for REINFORCED CONCRETE BEAM ANALYSIS
2.1.20.2= SUMMARY OF SECTION PROPERTIES OF RC-BEAM
2.1.20.3= SUMMARY OF REINFORCEMENT PROPERTIES OF RC-BEAM
2.1.23.1=WSD-INVENTORY BENDING STRESSES & RATING of RC-BEAM; TOP CONCRETE
2.1.23.1=WSD-INVENTORY BENDING STRESSES & RATING of RC-BEAM; TOP STEEL

Figure 7.6: A Typical Print Table Screen

7.5 Exit

Choosing 'Exit' tab exits the Print Utility and brings you back the ***WIN-DASH*** Main Menu.

7.6 Output Definitions and Options

Several different output options are available in the MERLIN-DASH system. These options provide the user with maximum flexibility in both the selection and the identification of the output for the various construction types and design specifications. These options are described below.

7.6.1 Index of Output Tables

Due to the extremely detailed output requirements for structural design problems, all output from MERLIN-DASH is indexed for user access and identification. The output is given in an 8 ½" x 11" tabular format and is categorized into four indices represented by TABLE I, J, K, L which are defined in Table 7.1.

Table 7.1 : Definition of Output Indices - TABLE I.J.K.L.

LABEL	CODE	NO.	DESCRIPTION
CONSTRUCTION TYPE	I	1	Composite Construction
		2	Non-composite Construction
SPECIFICATION	J	1	AASHTO - WSD
		2	AASHTO - LFD
INFORMATION TYPE	K	1	Index of Output
		2	Input Verification
		3	Design Notes
		4	Section Properties
		5	Moments
		6	Shears
		7	Reactions
		8	Deflections
		9	Stresses
		21	Code Check - WSD
		22	Code Check - LFD
		31	Rating - WSD
		32	Rating - LFD
		41	Minimum Cost Design - LFD
		42	Minimum Cost Design - WSD
NUMBER	L	N	*The Sequence Number:* 1 - N of the Output Table

7.6.2 Output Options

The amount of detail presented in ***MERLIN-DASH*** output tables is broken up into two levels. The user selects the output level using the ***WIN-DASH*** Input Screen: Basic Program Options.

Level 0 - Basic Engineering Output Level. This level of output has only those tables which are necessary for design (Table 7.2).

Level 1 - Detailed Engineering Output Level. Many more tables are output than required for basic engineering purposes (Table 7.2).

Table 7.2 : Definition of Output Tables for Composite Construction

TABLES APPLICABLE FOR: I = 1 - COMPOSITE CONSTRUCTION
J = 1 - AASHTO WSD

INDEX NO.	OUTPUT PHASE	TITLE	LEVEL (0,1)
1.1.1.1	ANALYSIS	PROGRAM ASSUMPTIONS	1
1.1.2.1		LOADING INFORMATION	1
1.1.3.1		BRIDGE SUPERSTRUCTURE QUANTITIES	1
1.1.3.2		DISTRIBUTION OF WHEEL LOADS	1
1.1.4.1		NON-COMPOSITE SECTION PROPERTIES FOR N = INFINITY	1
1.1.4.2		COMPOSITE SECTION PROPERTIES FOR N = 24.00	1
1.1.4.3		COMPOSITE SECTION PROPERTIES FOR N = 8.00	1
1.1.5.1		NON-COMPOSITE DEAD LOAD MOMENTS FOR N = INFINITY	1
1.1.5.3		COMPOSITE LIVE LOAD MOMENTS FOR N = 8.00	1
1.1.5.3A		LIVE LOAD MOMENT RANGE FOR N = 8.0 (k-ft)	1
1.1.5.4		MOMENT SUMMARY FOR COMPOSITE CONSTRUCTION	0, 1
1.1.6.1		NON-COMPOSITE DEAD LOAD SHEAR FOR N = INFINITY	1
1.1.6.2		NON-COMPOSITE AND COMPOSITE DL SHEAR SUMMARY	1
1.1.6.3		LIVE LOAD SHEAR FOR N = 8.0	1
1.1.6.3A		LIVE LOAD SHEAR RANGE FOR N = 8.0 (kips)	1
1.1.6.4		SHEAR SUMMARY FOR COMPOSITE CONSTRUCTION	0, 1
1.1.7.1		LIVE LOAD REACTIONS	1
1.1.7.2		SUMMARY OF REACTIONS	0, 1
1.1.8.1		COMP AND NON-COMP DL DEFL FOR INFINITY AND N = 24.0	1
1.1.8.1A		CAMBER INFORMATION	1
1.1.8.1B		LOCATION OF DEAD LOAD POINT OF CONTRA - FLEXURE	1
1.1.8.2		MAX. LIVE LOAD DEFLECTION FOR COMPOSITE CONST.	0, 1
1.1.9.1		NON-COMPOSITE DEAD LOAD STRESSES FOR N = INFINITY	1
1.1.9.2		COMP. DL STRESS FOR N = 24.0 AND TOTAL DL STRESSES	1
1.1.9.3		LIVE LOAD STRESSES FOR N = 8.0	1
1.1.9.3A		LIVE LOAD STRESS RANGE FOR N = 8.0 (ksi)	1
1.1.9.4		DL+LL+I STRESS SUMMARY FOR COMPOSITE CONSTRUCT.	0, 1
1.1.10.1	V	STRESSES AT SECTION-CHANGE POINTS	1

(continued)

Table 7.2 : Definition of Output Tables for Composite Construction*(continued)*

TABLES APPLICABLE FOR: I = 1 - COMPOSITE CONSTRUCTION
J = 1 - AASHTO WSD

INDEX NO.	OUTPUT PHASE	TITLE	LEVEL (0,1)
1.1.21.3	CODE	MEMBER LENGTH AND SECTION GEOMETRY	0, 1
1.1.21.4	CHECK	DEPTH RATIOS	1
1.1.21.5		ALLOW. SHEAR STRESS FOR UNSTIFFENED WEB ELEMENT	1
1.1.21.6		DEPTH/THICKNESS RATIOS	1
1.1.21.7		TRANSVERSE STIFFENER REQUIREMENT AND SPACING	0, 1
1.1.21.8		STATUS OF TRANSVERSE STIFFENERS	1
1.1.21.9		SECTION PROPERTIES CHECK OF TRANSVER. STIFFENERS	1
1.1.21.9A		BENDING CAPACITY REDUCTION FOR UNBRACED SECTION	0, 1
1.1.21.10		SHEAR STRESS CAPACITY CHECK	0, 1
1.1.21.11		COMPRESSION FLANGE ELEMENT CHECK	1
1.1.21.12		UNSUPPORTED LENGTH CHECK	1
1.1.21.13		MOMENT-SHEAR INTERACTION	1
1.1.21.14		ELASTIC SECTION MODULUS	1
1.1.21.15		DEAD LOAD STRESS ANALYSIS AT N = INFINITY	0, 1
1.1.21.16		WSD TOTAL STRESS ANALYSIS	0, 1
1.1.21.17		FATIGUE STRESS RANGE WITH LOADING	1
1.1.21.18A		FATIGUE STRESS RANGE FOR TRUCK	0, 1
1.1.21.18B		FATIGUE STRESS RANGE FOR LANE	0, 1
1.1.21.19		SHEAR CONNECTOR (FATIGUE CRITERIA)	0, 1
1.1.21.19A		SHEAR CONNECTOR (ULTIMATE STRENGTH CRITERIA)	0, 1
1.1.21.20		RE-BAR FATIGUE CHECK IN THE NEG. MOMENT REGION	1
1.1.21.21		UPLIFT CHECK	1
1.1.21.22		MAX. INDUCED STRESSES, F, IN THE BOTTOM FLANGE	1
1.1.21.23	V	MAX. HORIZ. FORCE IN THE DIAPH. & CROSS FRAMES	1

(continued)

Table 7.2 : Definition of Output Tables for Composite Construction*(continued)*

TABLES APPLICABLE FOR: I = 1 - COMPOSITE CONSTRUCTION J = 1 - AASHTO WSD			
INDEX NO.	**OUTPUT PHASE**	**TITLE**	**LEVEL (0,1)**
1.2.1.1	ANALYSIS	PROGRAM ASSUMPTIONS	1
1.2.2.1		LOADING INFORMATION	1
1.2.3.1		BRIDGE SUPERSTRUCTURE QUANTITIES	1
1.2.3.2		DISTRIBUTION OF WHEEL LOADS	1
1.2.4.1		NON-COMPOSITE SECTION PROPERTIES FOR N = INFINITY	1
1.2.4.2		COMPOSITE SECTION PROPERTIES FOR N = 27.00	1
1.2.4.3		COMPOSITE SECTION PROPERTIES FOR N = 9.00	1
1.2.5.1		NON-COMPOSITE D. L. MOMENTS FOR N = INFINITY (FACT.)	1
1.2.5.2		COMPOSITE D. L. MOMENTS FOR N = 27.00 (FACT.)	1
1.2.5.3		COMPOSITE L. L. MOMENTS FOR N = 9.00 (FACT.)	1
1.2.5.3A		L. L. MOMENT RANGE FOR N = 9.0 (k-ft) (UNFACT.)	1
1.2.5.4		MOMENT SUMMARY FOR COMPOSITE CONST. (FACT.)	0, 1
1.2.5.5		MOMENT SUMMARY FOR COMPOSITE CONST. (UNFACT.)	0, 1
1.2.6.1		NON-COMPOSITE D. L. SHEAR FOR N = INFINITY (FACT.)	1
1.2.6.2		NON-COMPOSITE AND COMPOSITE	1
		D.L. SHEAR SUMMARY (FACT.)	
1.2.6.3		L. L. SHEAR FOR N = 9.0 (FACT.)	1
1.2.6.3A		L. L. SHEAR RANGE FOR N = 9.0 (kips) (UNFACT.)	1
1.2.6.4		SHEAR SUMMARY FOR COMPOSITE CONST. (UNFACT)	0, 1
1.2.6.5		SHEAR SUMMARY FOR COMPOSITE CONSTRUCT. (FACT.)	0, 1
1.2.7.1		L. L. REACTIONS (UNFACT.)	1
1.2.7.2		SUMMARY OF REACTIONS (UNFACT.)	0, 1
1.2.8.1		COMPOSITE AND NON-COMPOSITE DL DEFLECTION	1
		FOR INFINITY & N = 27.0 (UNFACT.)	
1.2.8.1A		CAMBER INFORMATION(UNFACT.)	1
1.2.8.1B		LOCATION OF D.L. POINT OF CONTRA -FLEXURE (UNFACT.)	1
1.2.8.2		MAX. L.L. DEFLECTION FOR COMPOSITE CONSTRUCTION	0, 1
1.2.9.1		NON-COMP. D.L. STRESSES FOR N = INFINITY (UNFACT.)	1
1.2.9.2		COMPOSITE D.L. STRESS FOR N = 27.0 AND	1
		TOTAL D. L. STRESSES	
1.2.9.3		L. L. STRESSES FOR N = 9.0 (UNFACT.)	1
1.2.9.3A		L. L. STRESS RANGE FOR N = 9.0 (ksi) (UNFACT.)	1
1.2.9.4		TOTAL (DL+SDL+LL+I) STRESS SUMMARY (UNFACT.)	1
1.2.9.5		TOTAL (DL+LL+I) STRESS SUMMARY (FACT.)	0, 1
1.2.9.5 A-F		LRFD LIMIT STATE STRESS SUMMARY	1
1.2.10.1	V	STRESSES AT SECTION-CHANGE POINTS (UNFACT.)	1

(continued)

Table 7.2 : Definition of Output Tables for Composite Construction *(continued)*

TABLES APPLICABLE FOR: I = 1 - COMPOSITE CONSTRUCTION
J = 1 - AASHTO WSD

INDEX NO.	OUTPUT PHASE	TITLE	LEVEL (0,1)
1.2.22.1	CODE	DETAILED MOMENT INFORMATION	1
1.2.22.2	CHECK	DETAILED SHEAR INFORMATION	1
1.2.22.3		MEMBER LENGTH AND SECTION GEOMETRY	1
1.2.22.4		DEPTH RATIOS	1
1.2.22.5		DEPTH/THICKNESS RATIOS (N=n)	1
1.2.22.5A		DEPTH/THICKNESS RATIOS (N=INFINITY)	1
1.2.22.6		PROJECTING COMPRESSION FLANGE ELEMENT CHECK	1
1.2.22.6A		VALIDITY FOR INCREASING b'/ t RATIO	1
1.2.22.8		UNBRACED LENGTH CHECK	1
1.2.22.8A		BRACING POINT INFORMATION FOR N = INFINITY	1
1.2.22.8B		BRACING INFORMATION FOR LIVE LOAD CONDITION	1
1.2.22.8C		CHECK RADIUS OF GYRATION AND Dp FOR COMPACT SECTION	1
1.2.22.8D		LATERAL BRACING CHECK FOR REQRMNT. OF COMPACT SECT.	1
1.2.22.9		SUMMARY OF STRENGTH CATEGORY OF CROSS SECTION	1
1.2.22.9A		BENDING CAPACITY REDUCTION FOR UNBRACED SECTION	0, 1
1.2.22.10		BENDING CAPACITY FOR NON-COMPOSITE DEAD LOAD	0, 1
1.2.22.14		MAXIMUM STRENGTH FOR COMPOSITE SECTION	1
1.2.22.15		UNSTIFFENED SECTION SHEAR CAPACITY	1
1.2.22.16		SUMMARY OF WEB STRENGTH CATEGORY	0, 1
1.2.22.17		TRANSVERSE STIFFENER SPACING	1
1.2.22.18		STATUS OF TRANSVERSE STIFFENERS	1
1.2.22.19		SECTION PROPERTY CHECK OF TRANSVERSE STIFFENERS	0, 1
1.2.22.19A		REQ. SECTION PROPERTIES FOR TRANS. STIFFENERS	1
1.2.22.20		SHEAR CAPACITY CHECK	0, 1
1.2.22.21		OVERLOAD CHECK	0, 1
1.2.22.22		FATIGUE STRESS RANGE WITH LOADING (UNFACT.)	1
1.2.22.23A		FATIGUE STRESS RANGE FOR TRUCK (UNFACT.)	0, 1
1.2.22.23B		FATIGUE STRESS RANGE FOR LANE (UNFACT.)	0, 1
1.2.22.24		SHEAR CONNECTOR (FATIGUE CRITERIA) (UNFACT.)	0, 1
1.2.22.24A		SHEAR CONNECTOR (ULTIMATE STRENGTH CRITERIA)	0, 1
1.2.22.26		UPLIFT CHECK	1
1.2.22.27		MAX. INDUCED STRESSES, F, IN THE BOTTOM FLANGE	1
1.2.22.28		MAX. HORIZ. FORCE IN THE DIAPHRAGMS AND	1
		CROSS FRAMES	
1.2.22.29	V	SPLICE DESIGN AT SECTION CHANGE POINTS	0, 1

7.6.3 Definition of Output

A summary of the tables which are output from ***MERLIN-DASH*** are given in Table 7.2. Also defined in Table 7.2 are the specified levels and information type (e.g. analysis, code check, rating, etc.) associated with each set of tables. A summary of possible error messages from ***MERLIN-DASH*** is given in Table 7.3.

Table 7.3 : Error Messages

ERROR TYPE	ERROR IDENTIFICATION		REMEDY
	NO.	MESSAGE	
FATAL INPUT ERROR	1.1	SPAN INTERVAL ONLY ALLOWING MAXIMUM 20	Change SPAN INTERVAL on TYPE-01032 to be less than 21.
	1.2	DESIGN OPTION NOT DEFINED	Give DESIGN CODE on TYPE-01032.
NON-FATAL INPUT ERROR	3.1	BEAM XXX SPACING NOT GIVEN	Give BEAM SPACING on TYPE-03042.
NON-FATAL INPUT ERROR	4.1	SECTION NUMBER SEQUENCE WRONG	Check SECTION NUMBER SEQUENCE on TYPE 04012.
FATAL INPUT ERROR	5.1	SECTION NUMBER NOT GIVEN	Specify SECTION NUMBER on TYPE-05012.
	5.2	MEMBER LENGTH LESS THAN 1.0 FT.	Use BEAM MEMBER LENGTH more than 1.0 ft. on TYPE-05012.
	5.3	NO SUCH SECTION NUMBER	Redefine SECTION NUMBER on TYPE-05012.
	5.4	SUM OF MEMBER LENGTHS NOT MATCHING LENGTH OF BRIDGE	Check TOTAL LENGTH defined by TYPE-03022 and TYPE-05012.
FATAL INPUT ERROR	6.1	ROAD TYPE NOT GIVEN OR GIVEN WRONG FOR DESIGN CASE	Give correct ROAD TYPE on TYPE-06012.
FATAL INPUT ERROR	7.1	LIVE LOAD NOT GIVEN OR GIVEN WRONG	Check LIVE LOADING given on TYPES 06XXX and 07XXX.

REFERENCES

1. *Standard Specifications for Highway Bridges,* The American Association of State Highway and Transportation Officials, Seventeenth Edition with 2003 Interim.

2. *Manual of Steel Construction: Load and Resistance Factor Design,* American Institute of Steel Construction, Inc., Third Edition, 2001.

3. *Manual for Condition Evaluation of Bridges,* The American Association of State Highway and Transportation Officials, 1994.

4. *LRFD Bridge Design Specifications,* The American Association of State Highway and Transportation Officials, U.S. Units and S.I. Units, 6th Edition, 2012.

5. *The Manual for Bridge Evaluation,* 2nd Edition, 2010 with 2013 Interim.

Appendix A

TABLE A.1.2 STRUCTURAL DATA (DATA TYPE 03012)

INPUT ITEM	DESCRIPTION OF USAGE AND DEFAULT VALUES	FIGURE
NUMBER OF BEAMS	This integer is used in the automatic computation of the distribution factor. If the distribution factor is to be specified by the user (Data Type 08012), this must be left blank.	
POSITION: INTERIOR OR EXTERIOR	This integer is used in dead load calculations. If left blank, an interior beam is assumed by the system.	
WIDTH BETWEEN CURB OR BARRIER	This variable is used for calculating distribution factors. If distribution factors are specified by the user (Data Type 08012), this may be left blank.	
OVERHANG WIDTH	This variable is used for calculating distribution factors and section properties for an exterior beam. If an interior beam is being considered and distribution factors are specified by the user (Data Type 08012), this may be left blank.	
EDGE OF SLAB TO CURB	This variable is used for calculating distribution factors, section properties and sidewalk loading intensity for an exterior beam. If an interior beam is being considered and distribution factors are specified by the user (Data Type 08012), this may be left blank.	a = width between curbs or barriers b = overhang width c = edge of slab to curb d = haunch depth (top of steel web to the bottom of the slab for steel; top of beam to the bottom of slab for PC) e = haunch width
HAUNCH DEPTH HAUNCH WIDTH	These two variables are used for calculating section properties.	
PERCENT COMPOSITE	This variable refers only to the negative dead load moment region. If left blank, the system assumes 0.0%.	
DETAIL FACTOR	This factor is used as a multiple of the actual computed (and input) dead load intensity. This accounts for additional dead load such as splice connections, bolts, etc. If left blank, 1.0 is assumed.	

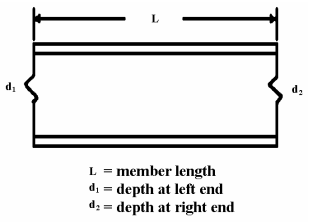
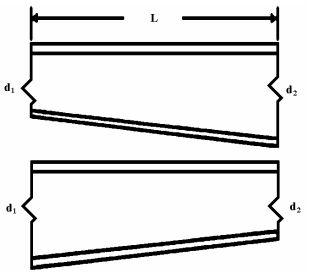
TABLE A.1.3 – DEFIN. OF MEMBER TYPES (DATA TYPE 05012; COLUMNS 30-32)							
MEMBER TYPE CODE	**DESCRIPTION**	**SECTION DEPTH**	**FLANGE THICKNESS**	**FLANGE WIDTH**	**FIGURE**	**PARAPETERS**	
						S_0	**S_1**
0	PRISMATIC MEMBER – • Open Section • Constant Web • Constant Flanges • No input required for parameters S0, S1 • As shown, d1 = d2	CONSTANT	CONSTANT	CONSTANT			
1	LINEARLY TAPERING MEMBER • Open section • Constant Flanges • Linear variation in web depth • No input required for parameter S0, S1 • As shown, d1 d2 or d1 d2	LINEAR VARIATION	CONSTANT	CONSTANT			

TABLE A.1.3 – DEFIN. OF MEMBER TYPES (DATA TYPE 05012; COLUMNS 30-32)

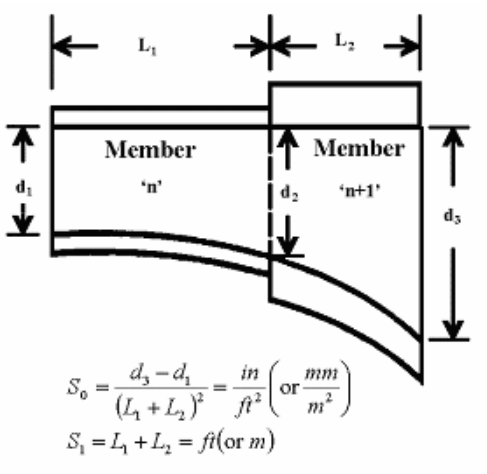
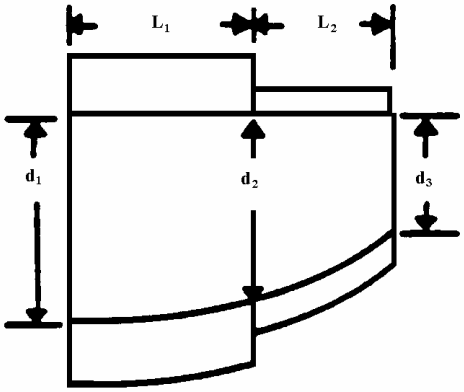
MEMBER TYPE CODE	DESCRIPTION	SECTION DEPTH	FLANGE THICKNESS	FLANGE WIDTH	FIGURE
2	HAUNCHED PARABOLIC MEMBER • S_0 = The parabolic constant that defines the variation in depth of the web. This value is positive for increasing depth and negative for decreasing depth. • S_1 = The length of the portion of the bridge for which a particular value of S_0, parabolic constant has been defined. S_1 equals the total length of the members within the parabolic range. • L_1 = the length of member n • L_2 = the length of member n+1	MEMBERS WITH INCREASING PARABOLIC WEB DEPTH	CONSTANT	CONSTANT	 $S_0 = \frac{d_3 - d_1}{(L_1 + L_2)^2} = \frac{in}{ft^2}\left(\text{or}\ \frac{mm}{m^2}\right)$ $S_1 = L_1 + L_2 = ft(\text{or } m)$
3	HAUNCHED PARABOLIC MEMBER • S_0 = The parabolic constant that defines the variation in depth of the web. This value is positive for increasing depth and negative for decreasing depth. • S_1 = The length of the portion of the bridge for which a particular value of S_0, parabolic constant has been defined. S_1 equals the total length of the member within the parabolic range. • L_1 = the length of member n • L_2 = the length of member n+1	MEMBERS WITH INCREASING PARABOLIC WEB DEPTH	CONSTANT	CONSTANT	 $S_0 = \frac{d_3 - d_1}{(L_1 + L_2)^2} = \frac{in}{ft^2}\left(\text{or}\ \frac{mm}{m^2}\right)$ $S_1 = L_1 + L_2 = ft(\text{or } m)$

TABLE A.1.4 – ALLOWABLE LIVE LOAD TYPES

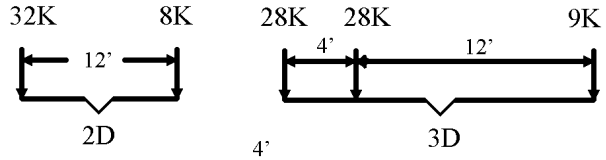
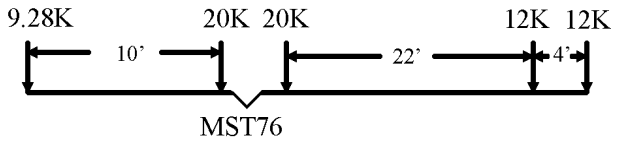
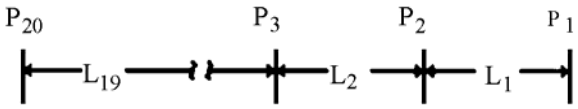
DATA TYPE	LOAD TYPE	DESCRIPTION	INPUT LOADING DESIGNATION	CONFIGURATION
06012	A	AASHTO LIVE LOADING	H-10, H-15 H-20, HS-15 HS-20, HS-XX	As given by the 1983 AASHTO Standard Specifications for Highway Bridges. HS loading can be specified by user up to HS-99.
06022	D	STATE VEHICULAR LANDING Maryland Standard DUMP TRUCKS (D)	2D, 3D	
06022	M	STATE VEHICULAR LOADING Maryland MAXIMUM ALLOWABLE TRUCK (M)	MST76, 3, 3S2, 3-3	
07022	C	SPECIAL VEHICLE May have up to 20 axles.	AS DEFINED BY USER.	

TABLE A.1.5 – FORMULATION OF THE IMPACT FACTOR

EQUATION NUMBER	EQUATION DEFINITION	COEFFICIENTS				COMMENTS
		C_1	C_2	C_3	C_4	
1	$I = C_1 / (C_2L + C_3)$	*	*	*		I = IMPACT FACTOR (%) L = LOADED LENGTH (FT) If no values are given, the AASHTO equation is automatically assumed. i.e. $C_1 = 50$, $C_2 = 1$, $C_3 = 125$ $I = \frac{50}{L + 125} = 0.30$

TABLE A.1.6 – DEFIN. OF DISTRIBUTION FACTOR OPTIONS (DATA TYPE 08012)	
APPLICATION OPTION	**DESCRIPTION**
0	The special distribution factor defined is not applied to the indicated loading type.
1	The special distribution factor defined is applied to the indicated loading type of calculations for all moments, shears, and deflections.
2	The special distribution factor defined is applied only to the loading types used for calculating moment.
3	The special distribution factor defined is applied only to the loading types used for calculating shear.
4	The special distribution factor defined is applied only to the loading types used for calculating deflection.

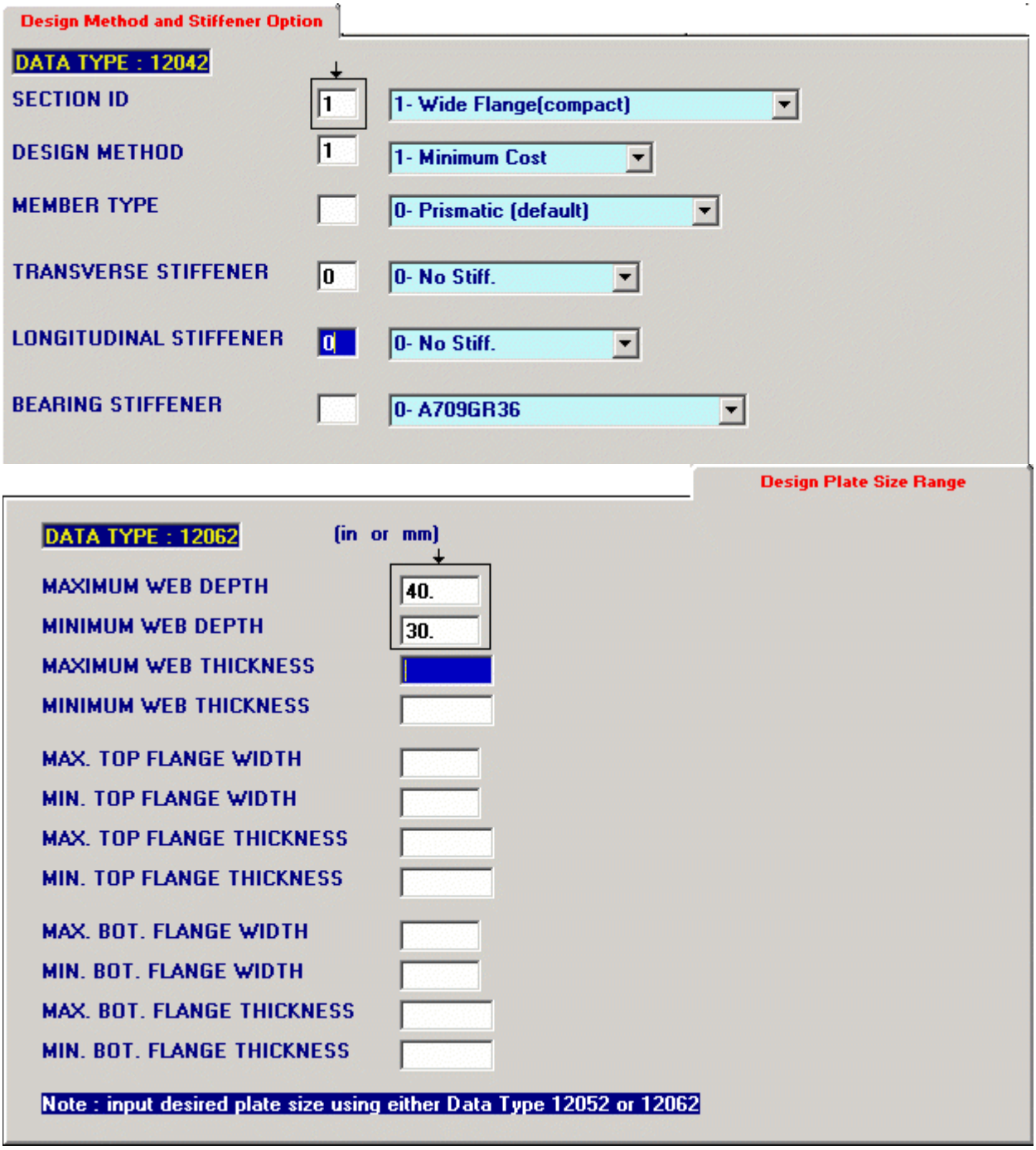
APPENDIX A1

EXAMPLES FOR ROLLED BEAM DESIGN AND STAGING

Rolled beam design is allowed since in Version 5.0 the user needs only to specify “Wide Flange” in the design option (see “example for Rolled Beam Design”).

Staging analysis will analyze the bridge after each pouring. The pouring days and segmented loads can be specified individually (see “Example for Staging”).

Example for Rolled Beam Design:



Note:

1. On Data Type 12042, Section ID is 1 for rolled beam design.
2. On Data Type 12052, designated constant Web Depth should be a nominal depth in AISC Steel Manual (i.e., W33).
3. Or on Data Type 12062, Web Depth range should be two AISC specified nominal depth (i.e., W30 to W40 as in the above screen).
4. On Data Type 12072, material may be defined (i.e., A36, A588, ..).

Example for Staging:

For Pouring Sequence check. You can get the same DASH input file and make change on 2 screens.

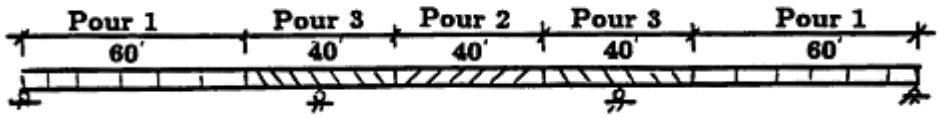
(1) Data Type 01032: Program Flow should be change to 7 for DL stage analysis or 8 for DL stage + LL analysis.

(2) Data Type 10012: The slab loads should be changed to loads in segment with different Pouring No., Pouring Day, and Distances. See example below:

Slab Loads

DATA TYPE : 10012

Load ID			Slab Data					Load Data		
Load No	Pouring No	Description	Init. Depth in or mm	Final Depth in or mm	Pouring Day	Module Ratio N1	Module Ratio N2	Intensity (K/Ft or KN/m)	Dist. From (Ft. or m)	Dist. To (Ft. or m)
1	1	SLAB LOAD	8.0	8.0	0	24.	8.	1.00	0.	60.
2	1	SLAB LOAD	8.0	8.0	0	24.	8.	1.00	180.	240.
3	2	SLAB LOAD	8.0	8.0	2	24.	8.	1.00	90.	150.
4	3	SLAB LOAD	8.0	8.0	4	24.	8.	1.00	60.	90.
5	3	SLAB LOAD	8.0	8.0	4	24.	8.	1.00	150.	180.
6	4	SLAB LOAD	8.0	8.0	28	24.	8.	0.00	0.0	240.
7										
8										
9										
10										
11										
12										
13										
14										



Pour 1: 0th day
2: 2nd day (2 days later)
3: 4th day (4 days later, after Pour 1)

STAGING ANALYSIS (Based on ACI 209)

a. Creep Coefficient (C_t):

The general form of the creep equation is

$$C_t = \frac{t^{\psi}}{d + t^{\psi}} C_u$$

where ψ and d are constants and C_u is the ultimate creep coefficient.

$$C_u = (C_u)_{avg} \cdot (CF)_{\ell a} \cdot (CF)_h$$

where $(C_u)_{avg} = 2.35$ and $(CF)_{\ell a}$ and $(CF)_h$ are correction factors for loading age and humidity, respectively.

b. Strength (f'_c):

The general form of the strength equation is:

$$(f'_c) = \frac{t}{\alpha + \beta t} (f'_c)_{28}$$

where α and β are constants depending on the concrete type.

c. Modulus of Elasticity (E_{ct}):

$$E_c = 1000 + 33\omega^{1.5} \sqrt{f'_c}$$

$$E_{ct} = \frac{E_c}{1 + C_t}$$

where E_{ct} is the effective modulus and is used to compute the modulus ratio between concrete and steel.

APPENDIX –A2

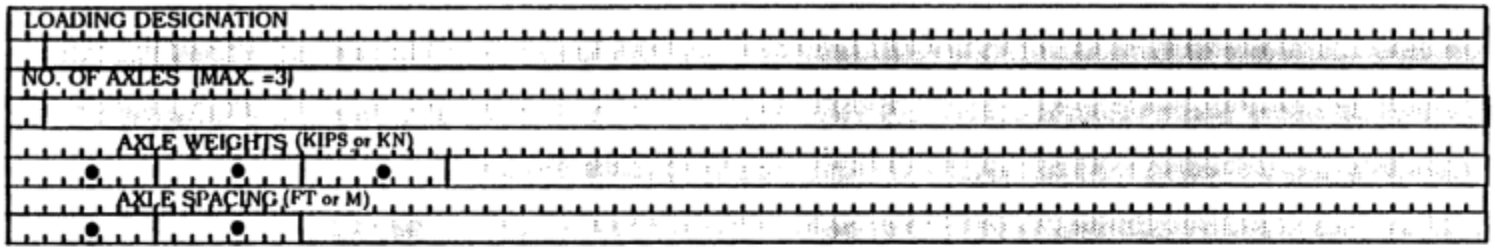
USER-SPECIFIED TRUCK FILE INPUT SHEET

As specified in Section 2.2, Methodology, user are allowed to specify their own trucks in a predefined truck file called either TRUCK26.DAT or TRUCK26M.DAT. When delivered, the software package includes the TRUCK26.DAT and TRUCK26M.DAT files with a few AASHTO rating trucks. Users are allowed to alter the existing truck records or to add their own State trucks by following the attached truck file input sheet. The users must take care that the truck names are unique. Otherwise, the wrong truck record may be found. Users are advised to check the input echo of the specified truck on the output.

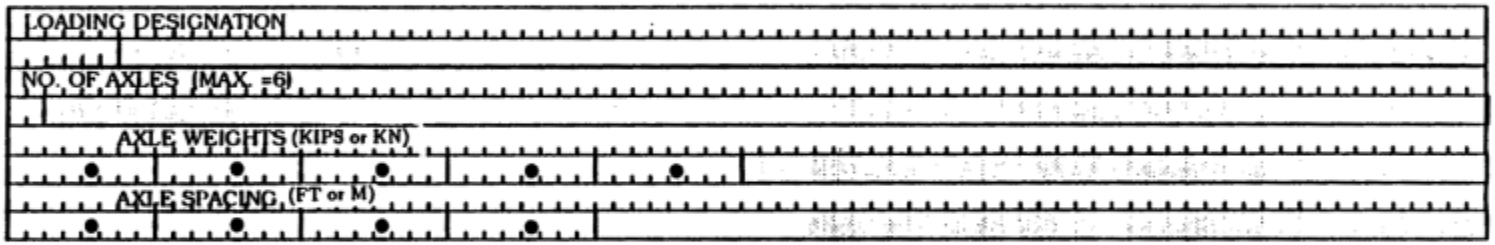
For trucks to be placed into the TRUCK26M.DAT (SI units) file, use KN instead of KIPS, and M instead of FT.

TRUCK FILE INPUT SHEET

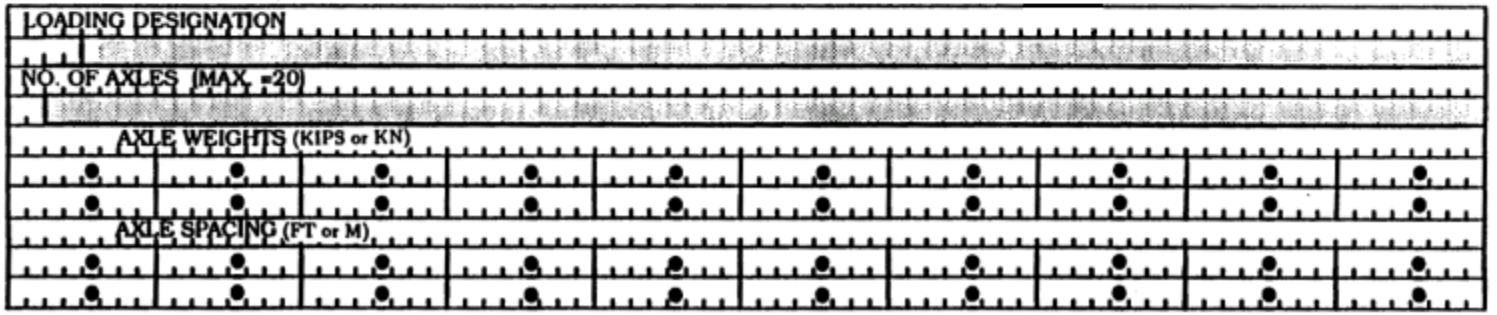
A. DUMP TRUCK IDENTIFICATION AND DESCRIPTION-LOAD TYPE D



B. MAXIMUM ALLOWABLE TRUCK IDENT. AND DESCRIPTION-LOAD TYPE M



C. GENERAL TRUCK IDENTIFICATION AND DESCRIPTION-LOAD TYPE G



Example for DASH multiple trucks

Step 1: Enter all trucks input TRUCK26.DAT file by following the truck loading designation (only once is needed)

1. Dump Truck (D). The only limitations for defining Dump Trucks are:
   Dump Truck Loading Designation - **2** Characters
   Number of Axles - **3** Axles
2. Maximum Allowable Truck (M). The limitations on user input are:
   Maximum Allowable Truck Loading Designation - **6** Characters
   Number of axles - **6** Axles
3. General Truck (G) & Special Truck (C). The limitations on user input are:
   General Loading Designation - **4** Characters
   Number of Axles - **20** Axles

So, in TRUCK26 file, the following names are used :

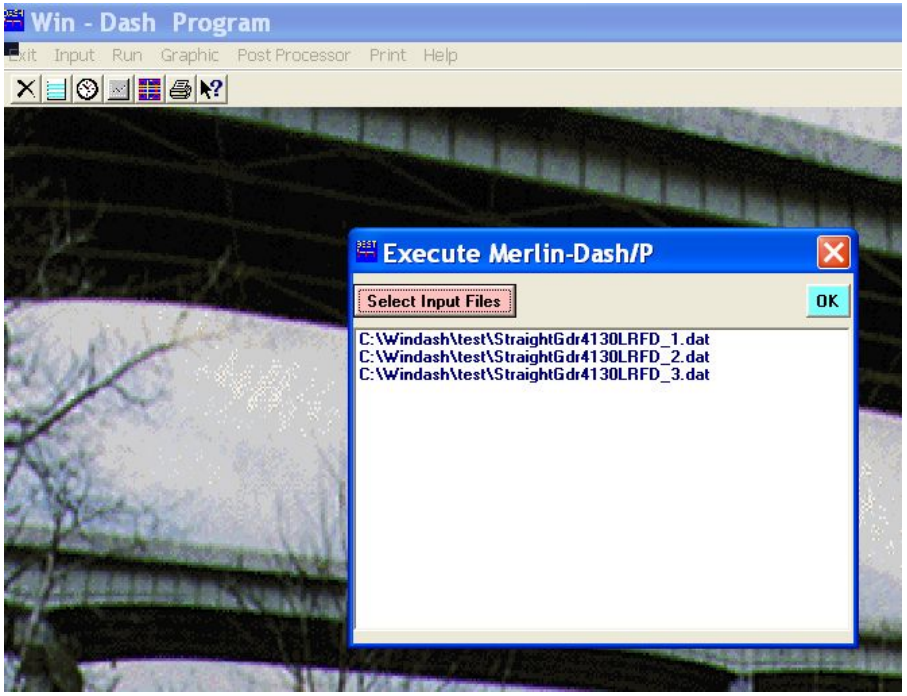
Vehicles	Original Names	Names in TRUCK26 file
1 (D truck, 2 axles)	ISH	I2
2 (D truck, 3 axles)	IS3A	3A
3 (D truck, 3 axles)	IS3C	3C
4 (4 axles)	IS4A	
5 (5 axles)	IS5A	
6 (6 axles)	IS6A	
7 (G truck, 7axles)	IS7A	
8 (G truck, 7axles)	IS7B	
9 (4 axles)	IT4A	
10 (5 axles)	IT5B	
11 (6 axles)	IT6A	
12 (G truck, 7axles)	IT7A	
13 (G truck, 7axles)	IT7B	
14 (D truck, 2 axles)	NSH	N2
15 (D truck, 2 axles)	S2	
16 (D truck, 3 axles)	NS3A	N3
17 (D truck, 3 axles)	S3	
18 (4 axles)	S4	

19 (5 axles)	NS5A	
20 (5 axles)	NS6A	
21 (G truck, 7axles)	NS7B	
22 (4 axles)	NT4A	
23 (4 axles)	T4	
24 (5 axles)	NT5B	
25 (5 axles)	T5A	
26 (5 axles)	T5B	
27 (6 axles)	NT6A	
28 (G truck, 7axles)	NT7A	
29 (G truck, 7axles)	NT7B	

Step 2: Make 11 run cases as follows:

Run case	D truck (3 axles max.)	M truck (6 axles max.)	G truck (20 axles max.)
1	ISH (I2)	IS4A	IS7A
2	IS3A (3A)	IS5A	IS7B
3	IS3C (3C)	IS6A	IT7A
4	NSH (N2)	NAGGR	NS7B
5	S2	NS5A	NT7A
6	NS3A (N3)	NS6A	NT7B
7	S3	NT4A	IT7B
8		IT4A	IT5B
9		T4	NT5B
10		T5A	T5B
11		IT6A	NT6A

Example of 3 runs together (, which can be expanded to 11 run cases shown above.)


Win - Dash Program
Exit Input Run Graphic Post Processor Print Help
Execute Merlin-Dash/P
Select Input Files
OK
C:\Windash\test\StraightGdr4130LRFD_1.dat
C:\Windash\test\StraightGdr4130LRFD_2.dat
C:\Windash\test\StraightGdr4130LRFD_3.dat

APPENDIX - A3

MORE INSIGHT ABOUT MERLIN-DASH

Listed below are detailed descriptions of entries in the
program; we hope that they give some insight into how to input and what the program assumes.

Structural Details (Data Type 03012):

No. of Beams: Following AASHTO Specifications, the program uses this parameter to average the live load deflection, assuming adequate cross bracing or diaphragms. The distribution factor for deflection is DF = 2 × NL/NB, where NL is number of lanes and NB is the number of beams.

Position (Int./Ext.): This program determines the effective slab width and the distribution factor based on AASHTO Specifications for interior and exterior beams. Default is interior beam.

Width between curbs: This entry will determine the number of lanes used in averaging the live load deflection. Min. of 12 ft. (one lane) is assumed by the program.

Overhang width: This entry will be used for the exterior beam to determine the effective width. For exterior beam to determine the effective width, the girder spacing S used for interior beam is replaced by S/2 + overhang width.

Edge of Slab to Curb: This parameter is used by the program to determine the sidewalk live loading. The sidewalk live loading specified by AASHTO in terms of lb/ft^2 times this parameter gives the distributed load in lb/ft. This distributed load will be applied to the influence lines to determine the max. and min. effects due to sidewalk live loading.

Haunch depth/thickness: The haunch will raise the slab above the beam. The program assumes haunches are constant all across the bridge. The haunch depth is always the distance from the bottom of the top flange or plate (or top of the steel web) to the bottom of the slab. If 0.0 is input, the steel top flange is inside the slab. The weight of the haunch should be included in the slab intensity input.

% of composite in the negative moment area: If 100.0 is used, the stiffness generation for analysis will include the concrete in the negative moment area. If this entry is 0 or blank,

and rebar is not specified in Data Type 12032, the stiffness generation for analysis will use bare steel section in the negative moment area. If this entry is 0 or blank, but rebar and shear studs are specified in the negative moment area, the stiffness generation for analysis will use combined rebar and steel section in the negative moment area.

Span Lengths (Data Type 03022):

The total of the span lengths will be used to check the total length defined in Data Type 05012 – Definition of Members, and Data Type 13012 – Yield Stresses and Lateral Bracing Data.

Hinges (Data Type 03032):

Hinge definition can be skipped if spans are continuous. The hinge can be defined at the piers to break the bridge into a series of simple spans or at any location as long as the structure is stable.

Beam Spacing (Data Type 03042):

Girder spacing is used to determine the effective slab width and distribution factor. As specified by AASHTO, if S exceeds 14', simple beam action will be used for calculating the distribution factor. For end shears and reactions, simple beam action will be used to calculate the shear and reaction distribution factors, which normally will give higher end shears and end reactions.

Definition of Sections (Data Type 04012):

More sections than used in Data Type 05012 may be defined here. The current version allows W, PG, and limited use of RC (reinforced concrete). Two utility programs are available to alter the contents of the Steel Section Table. Please contact your user support.

Definition of Members (Data Type 05012):

Members can be defined over the piers without breaks for Type 0. For other than Type 0, the member should be defined, separated where the slope changes. For Member Types 1, 2, or 3, the program will interpolate between two ends of the defined member to find the sections at the interval points for stress calculation. For hybrid member, please input yield strength in this screen.

AASHTO Live Load (Data Type 06012):

For loads higher than HS-20, HS-20 load will be used for the fatigue check. For tandem loading designations of 1, the tandem load of 2-24 loading will apply to the structure no matter what HS loading applies. For tandem loading designation of 2, the tandem load will be proportioned up from 2-24 loading. For example, if AASHTO loading is HS-25 and tandem loading designation is 2, the tandem load will be 2-30 kip loading.

Input for Type of Road will determine the fatigue allowables and the shear stud spacing calculation. Sidewalk loading is used to override the internal set of AASHTO sidewalk loading. Input sidewalk loading is a constant over the length of the bridge; it is not changed based on the span lengths.

Load Type D, M, & G (Data Types 06022 & 06032):

For Load Factor Method, these live loads will be considered as overload except that Type D can be designated as design vehicle in the maximum load calculation. The Load Factor Design live load considers:

(a) Maximum Load: AASHTO load (truck, land, and tandem) with or without design Type D truck times Gamma factor (1.3) and Beta factor (5/3);
(b) Overload Load: AASHTO load with any types D, M, and G trucks times Beta Factor (5/3):
(c) Service Load: AASHTO load only.

Note 1: Impact factor and distribution factor are calculated internally or overridden by the users and applied to the live load.
Note 2: User can access the ASCII file − TRUCK26.DAT (or TRUCK26M.DAT for metric version) to define their own trucks.

For Working Stress Method, all types are considered in the design/code checking process except fatigue check which only considers AASHTO load.

Load Type C (Data Types 07012 & 07022):

This loading is considered by itself and does not combine with any other load types. If this loading is specified, for LFD all other load types will be blocked out. As with the other load types for Data Types 06022 and 06032, users can access to the ASCII file − TRUCK26.DAT (or TRUCK26M.DAT for metric version) to define their own trucks. This option is used usually for the rating or capacity check and the direction of the truck can be specified.

Specification of Impact & Distribution Factors (Data Type 08012):

If default (i.e., skip this Data Type 08012), AASHTO impact and distribution factors will be imposed to the truck. The input is on a per span basis. If no impact is expected, input a very small impact factor value, such as 0.1%, and mark the loading type. The loading without impact is then specified. Maximum factor is to override the AASHTO max. factor and cap the impact factor calculated internally or by the input equation. The user can use the AASHTO impact factor and cap it by the input max. factor.

Individual moment, shear distribution, and deflection factors can be specified per span. Live Load Deflection is internally set as equally deflected for all beams/girders.

Gamma and Beta (Data Type 09012):

Gamma and Beta factors are the overriding factors to AASHTO 1.3 and 5/3. A new, second Beta factor will be the live load factor applied to the overload case.

Slab loads (Data Type 10012):

Slab loads are specified either for all spans or span by span. In the span-by-span case, load number corresponds to the Span No.; Distance From and Distance To should be the beginning and end of each span. Initial Depth is not used in the program and used only for reference. Final Depth is used for the section

calculation, effective width calculation and rebar location determination for composite construction. For noncomposite construction, thickness is not essential but, in the process of internal calculation, thickness will be used. Therefore, it is recommended to input a value to avoid divided overflow. To compute load intensity, user can input the uniform noncomposite load based on any slab thickness to be carried by the steel section.

Arbitrary Uniform and Concentrated Loads (Data Type 11012]:

Partially uniform loads and/or concentrated loads can be specified here at any location of the bridge during either DL or SDL stage. For noncomposite construction, it is only one stage − DL stage, and load stage is of no use. For composite construction, load type blank, 0, or1 are all for superimposed dead load and load type 2 is for dead load.

Reinforcement and Concrete Strength Data (Data Type 12032):

This Data Type has all the default values associated with each entry. If connectors are specified in the negative moment region and slab reinforcement entities are specified, steel section with rebar will be considered in the stiffness generation and stress calculation in the negative moment region. Rebar is not considered in the transformed section in the positive moment region.

Design Option (1) – (5) (Data Types 12042 – 12082):

These 5 Data Types will be used only for the design case and will be ignored for analysis, code checking, or rating. The six design parameters (web depth and thickness, top flange width and thickness, bottom flange width and thickness) can be fixed individually or can be given a tolerance value by specifying upper and lower limits. It is recommended not to specify one parameter, such as web depth, both fixed on Data Type 12052, and Max/Min Web depth on Data Type 12062. If nothing is specified on Data Types 12052 and 12062, the program will determine optimal sizes. User can define their designs from the first trial without specifying any design parameters.

If nothing is specified for material on Data Type 12072, A-709 with 36 ksi yield stress wil be used for design. Uniform (one material) or mixed (two or more materials) can be used for design, but not yet at this time for hybrid design.

If nothing is specified on Data Type 12082, the dead load point of contraflexure will be used as the field splice location. In this version, only one section is designed for each field section. If a more refined design is needed, users can specify their own splice locations. In the next version, up to 3 sections will be designed for each field section. For simple spans, if no splice locations are specified, up to three sections will always be considered.

Yield Stress and Lateral Bracing Data (Data Type 13012):

There are two different entities, Yield Stress and Lateral Bracing, on one Data Type. Locations From and To can be anywhere, ranged by material or by bracing distance. Lateral bracing distances are important for determining the allowable stresses for WSD and moment capacities for LFD. The bracing can be diaphragm

or crossframe where it prevents the compression flange from lateral buckling. If nothing is specified, 25', which corresponds to AASHTO specified max. diaphragm spacing, will be used for all code checking, rating, and design cases.

Note: The yield stress specified on Data Type 12072 is used only for design and the yield stress on Data Type 13012 is for code checking and rating. If your flow control choice is 6 (Design + Code Check), the yield stresses on both Data Types should be consistent.

Longitudinal Stiffener Data (Data Type 14012):

Longitudinal stiffeners are used for deep steel sections to resist shear and prevent web buckling. They should be used with transverse stiffeners, specified on Data Type 15012.

Transverse Stiffener Data (Data Type 15012):

Transverse stiffener data can be specified for code checking or left blank if users want the program to determine spacing. Within the specified locations From and To, spacing will be used for determining allowable shear stress for WSD and shear capacity for LFD.

Appendix A4 - WIN-DASH SPLICE DESIGN

TABLE 1.2.22.29A=SPLICE DESIGN AT SPLICE NO 1
****

SPLICE NO. 1 AT SPAN 1 DISTANCE FROM LEFT END IS 63.0 FEET

TOP PL = 12.00 X 0.750, BOTTOM PL = 16.00 X 0.875, WEB PL = 36.00 X 0.438

DESIGN FORCE FOR THE TOP PLATE	=	307.89 KIPS
& FOR THE BOTTOM PLATE	=	431.05 KIPS
DESIGN SHEAR FOR THE WEB PLATE	=	259.03 KIPS
& MOMENT FOR THE WEB PLATE	=	236.35 K-FT
& ECCENT FOR THE WEB PLATE	=	3.4 IN
& HORIZ. FORCE FOR THE WEB	=	263.6 KIPS
BOLT SPACING	=	3.0 IN
BOLT EDGE DISTANCE	=	1.5 IN

CONTROL FLANGE IS ON BOTTOM
COMPRESSION FLANGE IS ON BOTH

(A) WEB SPLICE DESIGN:

WEB PLATE SIZE: 2 PLATES 0.3750 X 30.00

WEB PLATE BOLTS: USE 2 COLUMNS OF 10 BOLTS FOR EACH COL (SIZE 0.875" DIA.)
(TOTALS ARE 4 COLUMNS WITH 40 BOLTS)

SHEAR FORCE 41.3 KIPS < THE SHEAR RESISTANCE OF THE BOLT 43.9 KIPS

SO, THE WEB BEARING IS OK

SHEAR FORCE 259.0 KIPS < THE SHEAR RESISTANCE OF THE PLATE 652.5 KIPS

SO, THE WEB SPLICE PLATE IS OK

WEB SPLICE BENDING STRESS 36.93 KSI < THE ALLOWABLE STRESS 50.00 KSI

SO, THE ADEQUACY OF WEB SPLICE PLATES IS OK

(B) TOP SPLICE DESIGN:

TOP PLATE SIZE: 1 PLT 0.3750 X 12.00 & 2 PLTS 0.3750 X 5.25

TOP PLATE BOLTS: USE 4 ROWS OF 2 BOLTS FOR EACH ROW (SIZE 0.875" DIA.)
(TOTALS ARE 8 ROWS WITH 16 BOLTS)

(C) BOTTOM SPLICE DESIGN:

BOTTOM PLATE SIZE: 1 PLT 0.3750 X 16.00 & 2 PLTS 0.3750 X 7.25

BOTTOM PLATE BOLTS: USE 3 ROWS OF 4 BOLTS FOR EACH ROW (SIZE 0.875" DIA.)
(TOTALS ARE 6 ROWS WITH 24 BOLTS)

F_{cf} = Design strength for the controlling flange at a point of splice

$F_{cf} = 1/2(|f_{cf}/R_h|+\alpha\phi_f F_{yf})$ (AASHTO LRFD 6.13.6.1.4C-1)

F_{cf} = 36.39 ksi (or AASHTO Std 10-4b)

or

$F_{cf} = 0.75\alpha\phi_f F_{yf}$ (AASHTO LRFD 6.13.6.1.4C-1)

F_{cf} = 37.50 ksi (governs) (or AASHTO Std 10-4b)

$\|f_{cf}/R\|$	αF_{yf}	$1/2(\|f_{cf}/R\|+a\phi_f F_{yf})$	$0.75*\alpha\phi_f F_{yf}$	F_{cf}
22.78	50.00	36.39	37.50	37.50

1.B: Top flange

f_{ncf} = Flexural stress due to the factored loads at the mid-thickness of the non-controlling flange at a point of splice concurrent with f_{cf}

f_{ncf} = -2.11 ksi

R_{cf} = Absolute value of the ratio of F_{cf} to f_{cf} for the controlling flange

$R_{cf} = |F_{cf}/f_{cf}|$

R_{cf} = 1.65

F_{ncf}= Design stress for the non-controlling flange at apoint of splice

$F_{ncf} = R_{cf}(|f_{ncf}/R_h|)$ (AASHTO LRFD 6.13.6.1.4C-2)

F_{ncf} = 3.47 ksi (or AASHTO Std 10-4c)

or

$F_{ncf} = 0.75\alpha\phi_f F_{yf}$

F_{ncf} = 37.50 ksi (governs)

f_{cf}	F_{yf}	R_h	α	f_{ncf}	ϕ_f	F_{ncf}
22.78	50.00	1.00	1.00	-2.11	1.00	37.50

$R_{cf} = \|F_{cf}/f_{cf}\|$	f_{cf}	$R_{cf}(\|f_{ncf}/R_h\|)$	$0.75*\alpha\phi_f F_{yf}$	F_{ncf}
1.65	22.78	3.47	37.50	37.50

2. Design force for the flange at a point of splice

2.A: Bottom Flange in tension and in control

Bolt size = d_b = 0.875 in. # Bolt Row = 2

Hole size = d_h = 0.94 in.

β = factor applied to the gross area of a flange to compute the effective flange area

$\beta = (A_n/A_g)((\phi_u F_u/\phi_y F_{yf}) - 1)$ when holes are equal to or less than 1.27" dia.

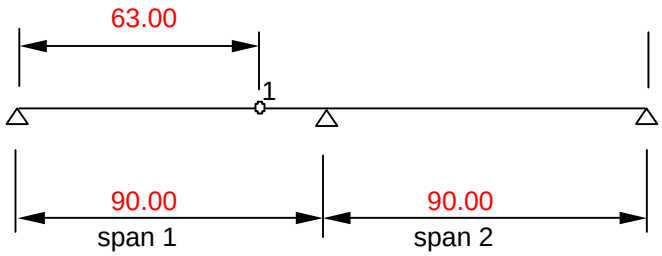
= 0.08

β = 0.00 when holes exceed 1.27" diameter

A_g = gross area of bottom flange = 14.00 in^2

A_n = net area of the flange (AASHTO LRFD 6.8.3)

Splice Design for S-1



Splice No. 1 at span 1(from DASH Table 1.2.22.29)

Distance from left support =	63 ft
Top Flange Plate =	12.00 in x 0.75 in
Bottom Flange Plate =	16.00 in x 0.875 in
Web Plate =	36.00 in x 0.4375 in

Plate Sizes	Wdth, in	Thickness, in
Top Plate	12.00	0.750
Bottom Plate	16.00	0.875
Web Plate	36.00	0.438

Stresses

Actual Factored Stresses (ksi) from DASH Table 1.2.9.5D (Strength I)			
Total Positive		Total Negative	
Top Flange	Bottom Flange	Top Flange	Bottom Flange
-2.11	22.78	-0.05	-14.58
Bolt Shear Design Strength =		36.50	ksi

1. Flange Allowable Stress/ Force

Control flange is the bottom flange. Where Compression flange is the top flange.

1.A: Bottom flange

f_{cf} = Maximum elastic flexural stress due to the factored loads at the mid-thickness of the controlling flange at the point of splice

f_{cf} = 22.78 ksi

R_h = Reduction factor for hybrid girders (AASHTO LRFD 6.13.6.1.4C)

R_h = 1.00 (or AASHTO Std 10.53.1.2)

F_{yf} = Specific minimum yield strength of the flange

F_{yf} = 50.00 ksi F_u = 65.00 ksi

α = Factor for flange splice design α = 1.00

ϕ_f = Resistance factor for flexural specified ϕ_f = 1.00 for flexural

f_{cf}	F_{yf}	F_u	R_h	α	ϕ_f
22.78	50.00	65.00	1.00	1.00	1.00

F_{cf} = Design strength for the controlling flange at a point of splice

$F_{cf} = 1/2(|f_{cf}/R_h|+\alpha\phi_f F_{yf})$ (AASHTO LRFD 6.13.6.1.4C-1)

F_{cf} = 36.39 ksi (or AASHTO Std 10-4b)

or

$F_{cf} = 0.75\alpha\phi_f F_{yf}$ (AASHTO LRFD 6.13.6.1.4C-1)

F_{cf} = 37.50 ksi (governs) (or AASHTO Std 10-4b)

$\|f_{cf}/R\|$	αF_{yf}	$1/2(\|f_{cf}/R\|+a\phi_f F_{yf})$	$0.75*\alpha\phi_f F_{yf}$	F_{cf}
22.78	50.00	36.39	37.50	37.50

1.B: Top flange

f_{ncf} = Flexural stress due to the factored loads at the mid-thickness of the non-controlling flange at a point of splice concurrent with f_{cf}

f_{ncf} = -2.11 ksi

R_{cf} = Absolute value of the ratio of F_{cf} to f_{cf} for the controlling flange

$R_{cf} = |F_{cf}/f_{cf}|$

R_{cf} = 1.65

F_{ncf}= Design stress for the non-controlling flange at apoint of splice

$F_{ncf} = R_{cf}(|f_{ncf}/R_h|)$ (AASHTO LRFD 6.13.6.1.4C-2)

F_{ncf} = 3.47 ksi (or AASHTO Std 10-4c)

or

$F_{ncf} = 0.75\alpha\phi_f F_{yf}$

F_{ncf} = 37.50 ksi (governs)

f_{cf}	F_{yf}	R_h	α	f_{ncf}	ϕ_f	F_{ncf}
22.78	50.00	1.00	1.00	-2.11	1.00	37.50

$R_{cf} = \|F_{cf}/f_{cf}\|$	f_{cf}	$R_{cf}(\|f_{ncf}/R_h\|)$	$0.75*\alpha\phi_f F_{yf}$	F_{ncf}
1.65	22.78	3.47	37.50	37.50

2. Design force for the flange at a point of splice

2.A: Bottom Flange in tension and in control

Bolt size = d_b = 0.875 in. # Bolt Row = 2

Hole size = d_h = 0.94 in.

β = factor applied to the gross area of a flange to compute the effective flange area

$\beta = (A_n/A_g)((\phi_u F_u/\phi_y F_{yf}) - 1)$ when holes are equal to or less than 1.27" dia.

= 0.08

β = 0.00 when holes exceed 1.27" diameter

A_g = gross area of bottom flange = 14.00 in^2

A_n = net area of the flange (AASHTO LRFD 6.8.3)

$A_n = A_g$ - # bolt row * d_h* t = 12.36 in^2 (or AASHTO Std 10.16.4)

ϕ_u = resistance factor for fracture of tension members = 0.80

ϕ_y = resistance factor for yielding of tension members = 0.95

(AASHTO LRFD 6.5.4.2)

A_e = Effective area of the bottom flange with holes

$A_e = A_n+\beta A_g <= A_g$ (AASHTO LRFD 6.10.3.6.1 or Std 10-4g)

A_e = 13.53 in^2 < A_g = 14.00 in^2 OK

P_{cf} = Design force for the controlling flange at a point of splice

$P_{cf} = F_{cf} * A_e$

P_{cf} = 507.38 Kips

A_e	F_{cf}	$P_{cf} = F_{cf} * A_e$
13.53	37.50	507.38

2B: Top Flange in compression and in non-control

A_g = Gross area of the top flange

A_g = 9.00 in^2

P_{ncf}= Design force in the non-controlling flange at a point of splice

$P_{ncf} = F_{ncf} * A_g$

P_{ncf} = 337.50 **Kips**

A_g	F_{ncf}	$P_{ncf} = F_{ncf} * A_g$
9.00	37.50	337.50

3. Calculate numbers of bolts on top and bottom flanges

3A. Bottom Splice in tension and in control

Outside Plate : 16" x 3/8"
Inside Plate : 2 - 6.5" x 3/8"

Plate	Wdth, in	Thickness, in	# of plates
Outside Plate :	16.00	0.375	1
Inside Plate :	6.50	0.375	2

P_{cf} = 507.38 Kips F_{yf} = 50.00 ksi

$A_{e,req}$ = 10.15 in^2

$\beta = (A_n/A_g)((\phi_u F_u/\phi_y F_{yf}) -1) >= 0.0$ when holes are equal to or less than 1.27" dia.

= 0.08

β = 0.00 when holes exceed 1.27" diameter

A_g = gross area of bottom flange = 10.88 in^2

A_n = net area of the flange (AASHTO LRFD 6.8.3)

$A_n = A_g$ - # bolt row * d_h* t = 9.47 in^2 (or AASHTO Std 10.16.4)

ϕ_u = resistance factor for fracture of tension members = 0.80

ϕ_y = resistance factor for yielding of tension members = 0.95
(AASHTO LRFD 6.5.4.2)

A_e = Effective area of the bottom flange with holes

$A_e = A_n+\beta A_g <= A_g$ (AASHTO LRFD 6.10.3.6.1 or Std 10-4g)

A_e = 10.37 in² > $A_{e,req}$ = 10.15 in² OK

Bolt diameter = d_b = 0.875 in.
Bolt Area = $A_b = \pi d_b^2/4$ = 0.60 in²
Bolt strength (double shear) = $P_{v\text{-}bolt}*2*A_b$ = 43.90 kips
Bolts required = $P_{cf}/P_{v\text{-}bolt}$ = 11.56

Use 12 bolts each side

P_{cf}, kips	$A_{e,req}$, in²	$P_{v\text{-}bolt}$, kips	required # Bolts	Use - Bolts/side
507.38	10.15	43.90	11.56	12

3B. Top Splice in compression and in non-control

Outside Plate : PL 12" x 3/8" Use the same width
Inside Plate : 2 - PL 5.25" x 1/2" Reduce by the web and clearence for the weld

Plate	Wdth, in	Thickness, in	# of plates
Outside Plate :	12.00	0.375	1
Inside Plate :	5.25	0.375	2

F_{ncf} = 37.50 ksi
P_{ncf} = 337.50 kips F_{yf} = 50.00 ksi
$A_{g,req}$ = 6.75 in²
$A_{g,provided}$ = 8.44 in² > $A_{e,req}$ OK

Bolts required = 7.69
Use 8 bolts each side

P_{ncf}	$A_{g,req}$	$P_{v\text{-}bolt}$	required # Bolts	Use - Bolts/side
337.50	6.75	43.90	7.69	8

4. Design force on web

4A: Design force due to moment

Web Plate = 36.00 in x 0.4375 in

R_h = 1.00 F_{cf} = 37.50 ksi
R_{cf} = 1.65 f_{ncf} = -2.11 ksi

M_{uw} = Design moment at the point of splice representing the portion of the flexural moment assumed to be resisted by the web

$M_{uw} = t_w D^2/12*|R_h F_{cf} - R_{cf} f_{ncf}|$ (AASHTO LRFD C6.13.6.1.4b-1)

= 1936.00 kips-in. (AASHTO Std 10-4l)
= 161.333 kips-ft

Bolt diameter = d_b = 0.875 in.

Bolt Area = $A_b = \pi d_b^2/4$ = 0.60 in^2

Bolt strength (double shear) = $0.6F_u*2*A_b$ = 43.90 kips

Bolt strength (bearing) $R_r = \phi_{bb}R_n = \phi_{bb}*(2.4*F_u*d_b*t_w)$ (AASHTO LRFD 6.13.2.9)

ϕ_{bb} = bolt bearing on material = 0.80 (AASHTO LRFD 6.5.4.2)

R_r = 47.78 kips

H_{uw} = Horizontal design force resultant in the web at a point of splice

H_{uw} = $t_wD/2*(R_hF_{cf}+R_{cf}f_{ncf})$ (AASHTO LRFD C6.13.6.1.4b-2)

= 267.96 kips (AASHTO Std 10-4m)

t_w , in.	D, in.	R_h	F_{cf} , ksi	f_{ncf} , ksi	R_{cf}	M_{uw}, kip-ft	H_{uw}, kips
0.4375	36.00	1.00	37.50	-2.11	1.65	161.33	267.96

4B: Design force due to shear

V_u = LRFD Max. Shear Table 1.2.22.16

V_u = 220.70 Kips

V_n = Unstiffened Shear Capacity

V_n = 297.40 Kips

V_r = ϕ_vV_n = $1.0*V_n$ = 297.40 kips

V_{uw} = Design shear in the web at the point of splice

$V_{uw} = 1.5*V_u$ = 331.05 kips ($V_u<0.5V_r$) (AASHTOLRFD 6.13.6.1.4b-2)

$V_{uw} = 1/2*(V+V_u)$ = 259.05 Kips ($V_u>0.5V_r$) (AASHTO Std 10-4i & 10-4j)

e = Distance from the centerline of the splice to the centroid of the connection on the side of the joint under consideration

e = 3.38 in.

M_{uv} = Design Moment due to the eccentricity of the design shear at the point of splice

$M_{uv} = V_{uw}*e$

M_{uv} = 72.86 Kips-ft

M_{total} = Total design moment (due to web flexure and eccentricity)

$M_{total} = M_{uv}+M_{uw}$ = 234.19 Kips-ft

V, kip	V_u, kip	V_{uw}, kip	e, in	M_{uv}, kip-ft	M_{uw}, kip-ft	M_{total}, kip-ft
220.70	297.40	259.05	3.38	72.86	161.33	234.19

m = no. of vertical rows of bolts = 2

n = no. of bolts in one vertical row = 10

s = the vertical pitch = 3.00 in.

g = the horizontal pitch = 3.00 in.

$I_p = nm/12*[s^2(n^2-1)+g^2(m^2-1)]$ = 1530.00 in^4

(AASHTO LRFD C6.13.6.1.4b-3)

m	n	s, in	g, in	I_p , in^4
2	10	3.00	3.00	1530.00

$P_s = V_{uw}/N_b = V_{uw}/(n*m) =$ 12.95 Kips

$P_H = H_{uw}/N_b = H_{uw}/(n*m) =$ 13.40 Kips

m	n	N_b	V_{uw}, kip	H_{uw}, kips	P_s, kip	P_H, kip
2	10	20	259.05	267.96	12.95	13.40

$P_{MV} = M_{total}*x/I_p = 237.644*12*1.5/1530 =$ 2.76 Kips

$P_{MH} = M_{total}*y/I_p = 237.644*12*13.5/1530 =$ 24.80 Kips

M_{total}, kip-ft	I_p, in^4	x, in	y, in	P_{MV}, kip	P_{MH}, kip
234.19	1530.00	1.50	13.50	2.76	24.80

$$P_r = \sqrt{(P_s + P_{MV})^2 + (P_H + P_{MH})^2}$$

$P_r =$ 41.30 Kips < $P_{vb} =$ 43.90 kips OK

P_s, kip	P_H, kip	P_{MV}, kip	P_{MH}, kip	P_r, kip		P_{vb},kips
12.95	13.40	2.76	24.80	41.30	<	43.90

5.Check flexural yielding of the web splice plates:

Web Splice Plate = 2 - PL 30 in x 0.375 in

d = 30.00 in.

t = 0.375 in.

$S_{pl} = 2*t*d^2/6 =$ 112.50 $in.^3$

$A_{pl} = 2*t*d =$ 22.50 in^2

t, in	d, in	S_{pl}	A_{pl}
0.375	30.00	112.50	22.50

$(M_{vu}+M_{uw})/S_{pl}+H_{uw}/A_{pl} < F_y$

$(M_{vu}+M_{uw})/S_{pl}+H_{uw}/A_{pl}=$ 36.89 ksi < $F_y =$ 50.00 ksi

ft	H_{uw}, kips	S_{pl}, in^3	A_{pl}, in^2	$M_{total}/S_{pl}+ H_{uw}/A_{pl}$	<	F_y
234.19	267.96	112.50	22.50	36.89	<	50.00

6. Check the factor resistance shear, (AASHTO LRFD 6.13.5.3)

(AASHTO LRFD 10.48.8)

$V_{uw} < R_r = \phi_v R_n = \phi_v*0.58A_{pl}.F_y$ (AASHTO LRFD 6.13.5.3-2 or Std 10-115)

$\phi_v =$ 1.00 (AASHTO LRFD 6.5.4.2)

$V_{uw} =$ 259.05 kips

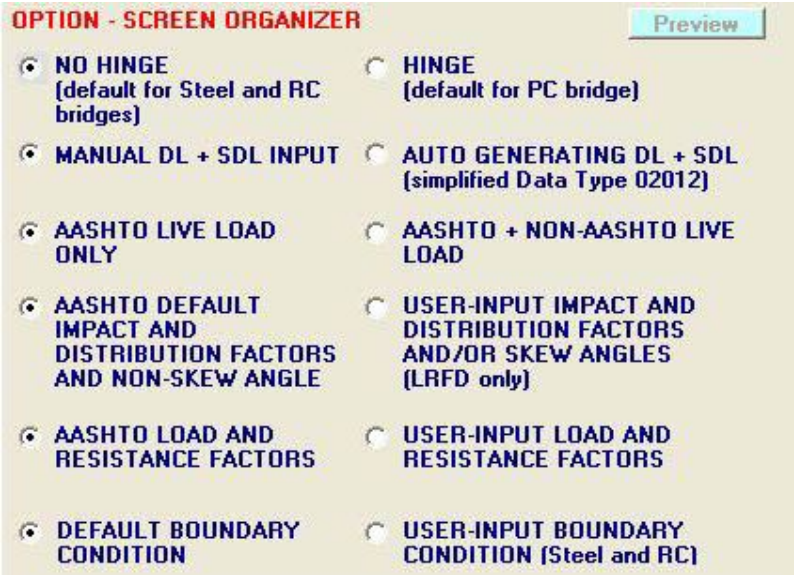
$R_r = \phi_v*0.58A_{pl}.F_y =$ 652.50 kips

$V_{uw} =$ 259.05 < 652.50 O.K.

A_{pl}, in^2	F_y, ksi	$\phi_v*0.58A_{pl}.F_y$	>	V_{uw}, kips
22.50	50.00	652.50	>	259.05

APPENDIX – A5

INPUT PROCESSOR OPTION – SCREEN ORGANIZER


OPTION - SCREEN ORGANIZER
Preview
NO HINGE (default for Steel and RC bridges)
HINGE (default for PC bridge)
MANUAL DL + SDL INPUT
AUTO GENERATING DL + SDL (simplified Data Type 02012)
AASHTO LIVE LOAD ONLY
AASHTO + NON-AASHTO LIVE LOAD
AASHTO DEFAULT IMPACT AND DISTRIBUTION FACTORS AND NON-SKEW ANGLE
USER-INPUT IMPACT AND DISTRIBUTION FACTORS AND/OR SKEW ANGLES (LRFD only)
AASHTO LOAD AND RESISTANCE FACTORS
USER-INPUT LOAD AND RESISTANCE FACTORS
DEFAULT BOUNDARY CONDITION
USER-INPUT BOUNDARY CONDITION (Steel and RC)

Option No.	Description	Screens On	Screen Off
1	No Hinge (Default for Steel and RC bridges)	-	03032
	Hinge (Default for PC bridge)	03032	-
2	Manual DL + SDL Input	10012, 11012	02012
	Auto Generating DL + SDL (Simplified Data Type 02012)	02012	10012, 11012
3	AASHTO Live Load Only	06012	06022, 06032, 07012, 07022
	AASHTO + Non-AASHTO Live Load	06012, 06022, 06032, 07012, 07022	-
4	AASHTO Default Impact and Distribution Factors and Non-skew Angle	-	08012
	User-input Impact and Distribution Factors and/or Skew Angles (LRFD only)	08012	-
5	AASHTO Load and Resistance Factors	-	09012
	User-input Load and Resistance Factors	09012	-
6	Default Boundary Condition	-	09022
	User-input Boundary Condition (Steel and RC)	09022	-

Appendix B1

LFD THEORY FOR PRESTRESSED CONCRETE

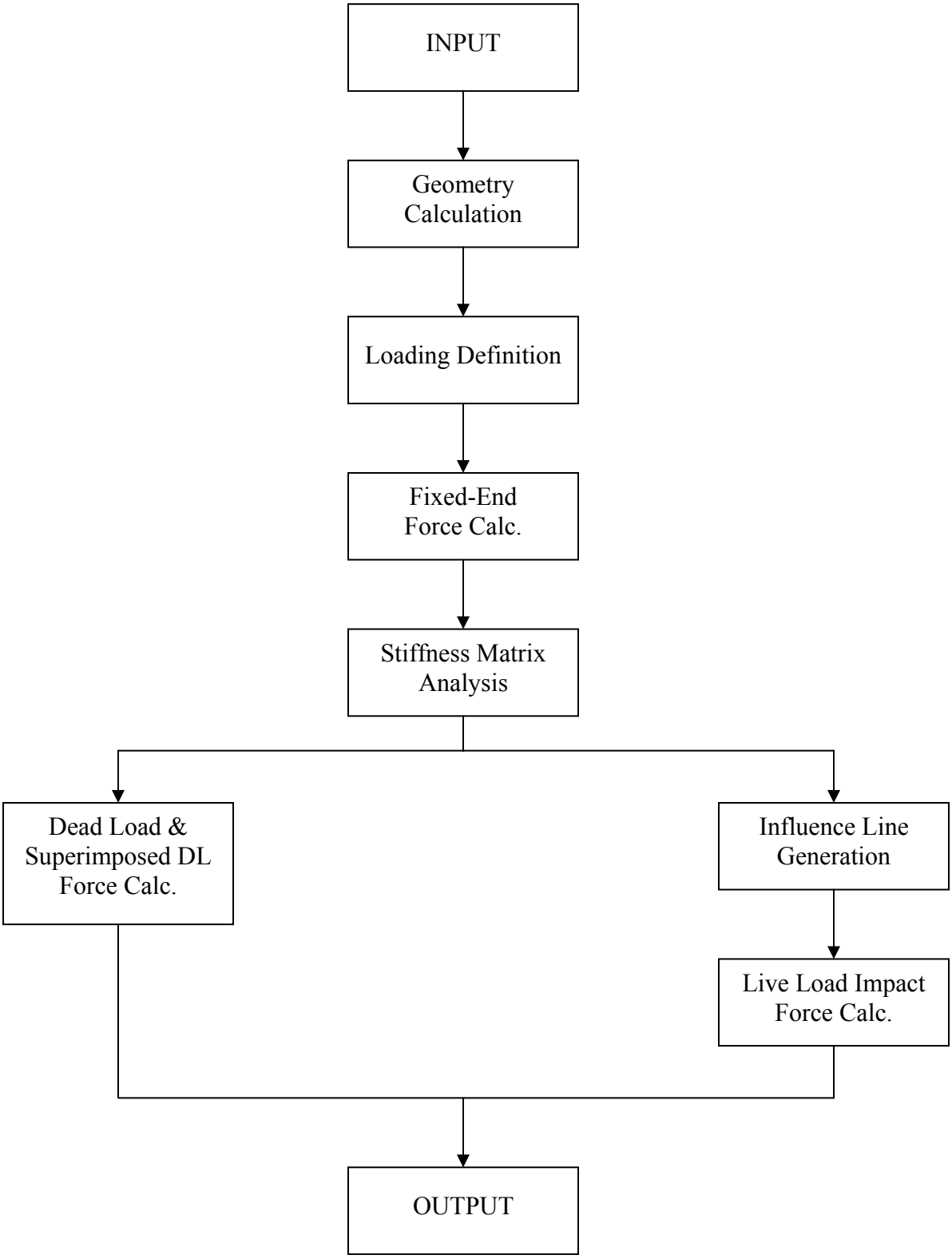
B1.1 General

DASH/P analyzes and performs the code check according to the most current AASHTO specifications. Structural analysis of the beam is performed by the program stiffness matrix solver. The program assumes the beam is a line element with translational and rotational degrees-of-freedom. The sizes of the elements and locations of the joints are totally dependent on the user input. The user can make a series of varied size beams to simulate the haunched member. Therefore, the user has complete control of the numerical model and the output. Since the program assumes simply supported beam at the first stage and then makes it continuous at later stages, the boundary conditions have to be preset for Dead Load Stage, Superimposed Dead Load Stage, and Live Load Stage.

AASHTO specifies that live load distribution factors and impact factors are also input by the users. With live load distribution factors, AASHTO permits computation of the truck applied to a single beam instead of the whole bridge.

With internally generated influence lines, AASHTO or any arbitrary trucks can be calculated individually.

B1.2 FLOW CHART



ALLOWABLE STRESSES

The concrete strength of precast prestressed members is in the Engineer's judgment. In cases where higher concrete strengths are considered, the Engineer shall satisfy himself completely that the controls over materials and fabrication procedures will provide the required strengths.

B1.2.1 Prestressing Steel Stresses at anchorages after seating for pretensioned members are:

.....0.70 f_s' for stress relieved strands

.....0.75 f_s' for low relaxation strands

B1.2.2 Temporary concrete stresses before losses due to creep and shrinkage

Compression

Pretensioned members .....0.60 f_{ci}'

Post-tensioned members .....0.55 f_{ci}'

Tension

Precompressed tensile zone ..... No temporary allowablestresses are specified.

Other Areas

In tension areas with

no bonded reinforcement .....200 psi or $3\sqrt{f_{ci}'}$

with bonded reinforcement ..... $7.5\sqrt{f_{ci}'}$

B1.2.3 Concrete stress at service load after losses have occurred

Compression ..... 0.40 f_c'

Tension in the precompressed tensile zone

(a) For members with bonded reinforcement* ..... $6\sqrt{f_c'}$

For severe corrosive exposure conditions,

such as coastal areas..... $3\sqrt{f_c'}$

(b) For members without bonded reinforcement.....0

(c) Modulus of rupture from tests or if not available.

For normal weight concrete ..... $7.5\sqrt{f_c'}$

For sand-lightweight concrete..... $6.3\sqrt{f_c'}$

For all other lightweight concrete..... $5.5\sqrt{f_c'}$

B1.3 LOSS OF PRESTRESS

B1.3.1 Friction Losses

These friction losses are calculated as follows:

$$T_o = T_x\, e^{(KL+\mu\alpha)}$$

When $(KL + \mu\alpha)$ is not greater than 0.3, the following equation is used:

$$T_o = T_x\,(1 + KL + \mu\alpha) \qquad \text{AASHTO (9-2)}$$

The following values for K and μ may be used when experimental data for the materials used are not available:

Type of Steel	Type of Duct	K/ft	μ
Wire or strand	Rigid and semi-rigid galvanized metal sheathing	0.0002	0.15 – 0.25**
	Polyethylene	0.0002	0.23
	Rigid steel pipe	0.0002	0.25***
High-strength bars	Galvanized metal sheathing	0.0002	0.15

** A friction coefficient of 0.25 is appropriate for 12 strand tendons. A lower coefficient may be used for larger tendon and duct sizes.

*** Lubrication will probably be required.

B1.3.2 Prestress Losses Due to Shrinkage

Pretensioned Members

$$SH = 17{,}000 - 150\ RH \qquad \text{AASHTO (9-4)}$$

Post-tensioned Members

$$SH = 0.80\ (17{,}000 - 150\ RH) \qquad \text{AASHTO (9-5)}$$

where RH = mean annual ambient relative humidity in percent.

B1.3.3 Prestress Losses Due to Elastic Shortening

Pretensioned Members

$$ES = \frac{E_s}{E_{ci}} f_{cir} \qquad \text{AASHTO (9-6)}$$

Post-tensioned Members

$$ES = 0.5\frac{E_s}{E_{ci}}f_{cir}$$ AASHTO (9-7)

where

E_s = modulus of elasticity of prestressing steel strand.
E_{ci} = modulus of elasticity of concrete in psi at transfer of stress.
f_{cir} = concrete stress at the center of gravity of the prestressing steel due to prestressing force and dead load of beam immediately after transfer.

B1.3.4 Prestressed losses due to Creep of Concrete

Pretensioned and post-tensioned members.

$$CR_c = 12\ f_{cir} - 7\ f_{cds}$$ AASHTO (9-9)

where

f_{cds} = concrete stress at the center of gravity of the prestressing steel due to all dead loads except the dead load present at the time the prestressing force is applied.

B1.3.5 Prestress Losses due to Relaxation of Prestressing Steel

Pretensioned Members

250 to 270 ksi Strand

$CR_s = 20{,}000 - 0.4\ ES - 0.2\ (SH + CR_c)$
for stress relieved strand AASHTO (9-10)

$CR_s = 5{,}000 - 0.10\ ES - 0.05\ (SH + CR_c)$
for low relaxation strand AASHTO (9-10A)

Post-tensioned Member

250 to 270 ksi Strand

$CR_s = 20{,}000 - 0.3\ FR - 0.4\ ES - 0.2\ (SH + CR_c)$
for stress relieved strand AASHTO (9-11)

$CR_s = 5{,}000 - 0.07\ FR - 0.1\ ES - 0.05\ (SH + CR_c)$
for low relaxation strand (9-11A)

240 ksi Wire

$$CR_s = 18{,}000 - 0.3\ FR - 0.4\ ES - 0.2\ (SH + CR_c) \qquad (9\text{-}12)$$

where

FR = friction loss stress reduction in psi below the level of 0.70 f_s' at the point under consideration.

ES, SH, and CR_c = appropriate values as determined for either pretensioned or post-tensioned members.

B1.3.6 Estimated Losses

Loss of prestress due to all causes, excluding friction, is determined by the following method.

TOTAL LOSS

$$\Delta f_s = SH + ES + CR_c + CR_s \qquad \text{AASHTO (9-3)}$$

where

Δf_s = total loss excluding friction in pounds per square inch;
SH = loss due to concrete shrinkage in pounds per square inch;
ES = loss due to elastic shortening in pounds per square inch;
CR_c = loss due to creep of concrete in pounds per square inch;
CR_s = loss due to relaxation of prestressing steel in pounds per square inch.

B1.4 FLEXURAL STRENGTH

B1.4.1 Rectangular Sections

For rectangular or flanged sections having prestressing steel only, which the depth of the equivalent in rectangular stress block, defined as $(A_s^* f_{su}^*)/(0.85\ f_c' b)$, is not greater than the compression flange thickness "t", and which satisfy AASHTO Eq. (9-20), the design flexural strength shall be assumed as

$$\Phi M_n = \Phi\left[A_s^* f_{su}^* d\left(1 - 0.6\frac{p^* f_{su}^*}{f_c'} \right) \right] \qquad \text{AASHTO (9-13)}$$

For rectangular or flanged sections with non-prestressed tension reinforcement included, in which the depth of the equivalent rectangular stress block, defined as $(A_s^* f_{su}^* + A_s f_{sy})/(0.85\ f_c' b)$, is not greater than the compression flange thickness "t", and which satisfy AASHTO Eq. (9-24), the design flexural strength shall be assumed as

$$\Phi M_n = \Phi\left\{ A_s^* f_{su}^* \left[1 - 0.6\left(\frac{p^* f_{su}^*}{f_c'} + \frac{d_t}{d}\frac{P f_{sy}}{f_e'} \right) \right] + A_s f_{sy} d_t \left[1 - 0.6\left(\frac{d}{d_t}\frac{P^* f_{su}^*}{f_c'} + \frac{p f_{sy}}{f_c'} \right) \right] \right\}$$

AASHTO (9-13a)

B1.4.2 Flanged Sections

For sections having prestressing steel only, in which the depth of the equivalent rectangular stress block, defined as $(A_{sr}f^*_{su})/(0.85f'_c\,b')$ is greater than the compression flange thickness "t", and which satisfy AASHTO Eq. (9-21), the design flexural strength is

$$\Phi M_n = \Phi\left\{A_{sr}f^*_{su}d\left[1-0.6\left(\frac{A_{sr}f^*_{su}}{b'df'_c}\right)\right]+0.85f'_c\,(b-b')(t)(d-0.5t)\right\} \qquad \text{AASHTO (9-14)}$$

For sections with non-prestressed tension reinforcement included, in which the depth of the equivalent rectangular stress block, defined as $(A_{sr}f^*_{su})/(0.85f'_c\,b')$, is greater than the compression flange thickness "t", and which satisfy AASHTO Eq. (9-25), the design flexural strength is

$$\Phi M_n = \Phi\left\{A_{sr}f^*_{su}d\left[1-0.6\left(\frac{A_{sr}f^*_{su}}{b'df'_c}\right)\right]+A_sf_{sy}(d_t-d)+0.85f'_c\,(b-b')(t)(d-0.5t)\right\}$$

AASHTO (9-14a)

where

A_{sr} = $A^*_s - A_{sf}$ in Eq. (9-14); AASHTO (9-15)

A_{sr} = $A^*_s + (A_sf_{sy}/f^*_{su}) - A_{sf}$, in Eq. (9-14a) AASHTO (9-15a)

A_{sf} = $0.85f'_c\,(b-b')t/f^*_{su}$; AASHTO (9-16)

A_{sf} = the steel area required to develop the ultimate compressive strength of the overhanging portions of the flange.

B1.4.3 Steel Stress

Bonded Members . . .
with prestressing only;

$$f^*_{su} = f'_s\left[1-(\gamma^*/\beta_1)(p^*f'_s/f'_c)\right] \qquad \text{AASHTO (9-17)}$$

with non-prestressed tension reinforcement included;

$$f'_{su} = f'_s\left\{1-\frac{\gamma^*}{\beta_1}\left[\frac{p^*f'_s}{f'_c}+\frac{d_t}{d}\left(\frac{pf_{sy}}{f'_c}\right)\right]\right\} \qquad \text{AASHTO (9-17a)}$$

Unbonded members . . . $f_{su}^* = f_{se} + 900\,((d - y_u)/l_e)$ AASHTO (9-18)

B1.5 DUCTILITY LIMITS

B1.5.1 Maximum Prestressing Steel

Prestressed concrete members are designed so that the steel is yielding as ultimate capacity is approached. In general, the reinforcement index is such that:

$$\left(p^* f_{su}^*\right)/f_c' \text{ for rectangular sections} \qquad \text{AASHTO (9-20)}$$

and

$$A_{su} f_{su}^* /\left(b'df_c'\right) \text{ for flanged sections} \qquad \text{AASHTO (9-21)}$$

does not exceed $0.36\beta_1$.

For members with reinforcement indices greater that $0.36\beta_1$, the design flexural strength is not greater than:

For rectangular sections

$$\Phi M_n = \Phi\left[\left(0.36\beta_1 - 0.08\beta_1^2\right) f_c' b d^2\right] \qquad \text{AASHTO (9-22)}$$

For flanged sections

$$\Phi M_n = \Phi\left[\left(0.36\beta_1 - 0.08\beta_1^2\right) f_c' b' d^2 + 0.85 f_c' (b - b') t (d - 0.5t)\right] \qquad \text{AASHTO (9-23)}$$

B1.5.2 Minimum Steel

The total amount of prestressed and non-prestressed reinforcement shall be adequate to develop an ultimate moment at the critical section at least 1.2 times the cracking moment M_{cr}^*.

$$\Phi M_n \geq 1.2 M_{cr}^*$$

where

$$M_{cr}^* = \left(f_r + f_{pe}\right) S_c - M_{d/nc}\left(S_c / S_b - 1\right)$$

Appropriate values for $M_{d/nc}$ and S_b are used for any intermediate composite sections. Where beams are designed to be non-composite, substitute S_b for S_c in the above equation for the calculation of M_{cr}^*.

B1.6 SHEAR

B1.6.1 General

Members subject to shear are designed so that

$$V_u \le \Phi\left(V_c + V_s\right) \qquad \text{AASHTO (9-26)}$$

where V_u is the factored shear force at the section considered, V_c is the nominal shear strength provided by concrete and V_s is the nominal shear strength provided by web reinforcement.

B1.6.2 Shear Strength Provided by Concrete

The shear strength provided by concrete, V_c, is taken as the lesser of the values V_{ci} or V_{cw}.

The shear strength, V_{ci}, is computed by

$$V_{ci} = 0.6\sqrt{f_c'}b'd + V_d + \frac{V_i M_{cr}}{M_{\max}} \qquad \text{AASHTO (9-27)}$$

but need not be less than $1.7\sqrt{f_c'}b'd$ and d need not be taken less than 0.8h.

The moment causing flexural cracking at the section due to externally applied loads, M_{cr}, is computed by

$$\mathrm{M_{cr}} = \frac{1}{\mathrm{Y_t}}\left(6\sqrt{\mathrm{f_c'}} + \mathrm{f_{pe}} - \mathrm{f_d}\right) \qquad \text{AASHTO (9-28)}$$

The maximum factored moment and factored shear at the section due to externally applied loads, M_{max} and V_1, are computed from the load combination causing maximum moment at the section.

The shear strength, V_{cw}, is computed by

$$V_{cw} = \left(3.5\sqrt{f_c'} + 0.3f_{pc}\right)b'd + V_p \qquad \text{AASHTO (9-29)}$$

but d need not be taken less than 0.8h.

Shear Strength Provided by Web Reinforcement

The shear strength provided by web reinforcement is taken as

$$V_s = \frac{A_v f_{sy} d}{s} \qquad \text{AASHTO (9-30)}$$

where A_v is the area of web reinforcement within a distance s. V_s is not taken greater than $8\sqrt{f_c'}b'd$.

The spacing of web reinforcing shall not exceed 0.75h or 24 inches. When V_s exceeds $4\sqrt{f_c'}b'd$, this maximum spacing is reduced by one-half.

The minimum area of web reinforcement is

$$A_v = \frac{50b's}{f_{sy}} \qquad \text{AASHTO (9-31)}$$

where b' and s are in inches and f_{sy} is in psi.

Appendix B2

LRFD THEORY FOR PRESTRESSED CONCRETE

B2.1 TABLE 3.2.6.6 SUMMARY OF BOTTOM STRESSES AT RELEASE
TABLE 3.2.6.7 SUMMARY OF TOP STRESSES AT RELEASE

Stress limits for concrete at release (LRFD Art. 5.9.4.1):

1. Compression for pretensioned or post-tensioned members, $0.60 f'_{ci}$
2. Tension:
   a) in areas without bounded auxiliary reinforcement, $0.0948\sqrt{f'_{ci}} \le 0.2$ ksi
   b) in areas with bounded reinforcement which is sufficient to resist the tension force in the concrete computed assuming an uncracked section, $0.24\sqrt{f'_{ci}}$ ksi

B2.2 TABLE 3.2.6.8A SUMMARY OF BOTTOM STRESSES AT SERVICE LOAD
TABLE 3.2.6.8B SUMMARY OF BOTTOM STRESSES AT SERVICE III LOAD CASE I
TABLE 3.2.6.8C SUMMARY OF BOTTOM STRESSES AT SERVICE III LOAD CASE II/III
TABLE 3.2.6.9A SUMMARY OF TOP STRESSES AT SERVICE LOAD
TABLE 3.2.6.9B SUMMARY OF TOP STRESSES AT SERVICE III LOAD CASE I
TABLE 3.2.6.9C SUMMARY OF TOP STRESSES AT SERVICE III LOAD CASE II/III

1. Compression using the service limit state Load Combination I:
   a) due to permanent (dead) load, (i.e. beam self-weight, deck slab weight, diaphragm weight, wearing surface and barrier weights), $0.45 f'_c$
   b) due to permanent and transient loads, i.e. all dead loads and live loads, and during shipping and handling, $0.60 f'_c$
   c) due to live load and one-half of the permanent loads, $0.40 f'_c$
2. Tension using the service limit state Load Combination III, where only 80% of the live load effects are considered:
   a) for components with bonded prestressing tendons other than piles, $0.19\sqrt{f'_c}$, ksi
   b) for components subject to serve corrosive conditions, $0.0948\sqrt{f'_c}$, ksi
   c) for components with unbonded prestressing, no tension is allowed

B2.3 TABLE 3.2.6.11 SUMMARY OF ULTIMATE MOMENT
TABLE 3.2.6.11A DETAILS OF ULTIMATE MOMENT CALCULATION

The average stress in bonded prestressing steel, $f_{ps} = f_{pu}\left(1 - k\frac{c}{d_p}\right)$ (LRFD Eq. 5.7.3.1.1-1)

Assuming rectangular section behavior, the neutral axis depth:

$$c = \frac{A_{ps} f_{pu} + A_s f_y - A'_s f'_y}{0.85 f'_c \beta_1 b + k A_{ps} \frac{f_{pu}}{d_p}}$$ (LRFD Eq. 5.7.3.1.1-4)

where

c = distance between the neutral axis and the compressive face
A_{ps} = area of prestressing steel
f_{pu} = specified tensile strength of prestressing steel
A_s = are of mild steel tension reinforcement
f_y = yield strength of tension reinforcement
A'_s = area of compression reinforcement
f'_y = yield strength of compression reinforcement
b = width of compression of flange
k = factor related to type of strand:

$$= 2\left(1.04 - \frac{f_{py}}{f_{pu}}\right) \qquad \text{(LRFD Eq. 5.7.3.1.1-2)}$$

= 0.28 for low relaxation strand
f_{py} = yield strength of prestressing steel
d_p = distance from extreme compression fiber to the centroid of the prestressing strand

The depth of the compression block, $a = \beta_1 c$. If $a > h_f$ (depth of the compression flange), flanged section behavior must be used with c calculated by:

$$c = \frac{A_{ps} f_{pu} + A_s f_y - A'_s f'_y - 0.85\beta_1 f'_c (b - b_w) h_f}{0.85 f'_c \beta_1 b_w + k A_{ps} \frac{f_{pu}}{d_p}} \qquad \text{(LRFD Eq. 5.7.3.1.1-3)}$$

where b_w = width of web

(a) Rectangular Sections

$$M_n = A_{ps} f_{ps}\left(d_p - \frac{a}{2}\right) + A_s f_y\left(d_s - \frac{a}{2}\right) - A'_s f'_y\left(d' - \frac{a}{2}\right) \qquad \text{(LRFD Eq. 5.7.3.2.2-1)}$$

(b) Flanged Sections

$$M_n = A_{ps} f_{ps}\left(d_p - \frac{a}{2}\right) + A_s f_y\left(d_s - \frac{a}{2}\right) - A'_s f'_y\left(d' - \frac{a}{2}\right) + 0.85 f'_c (b - b_w)\beta_1 h_f\left(\frac{a}{2} - \frac{h_f}{2}\right)$$

Where

f_{ps} = average stress in prestressing steel
a = depth of the equivalent stress block = ($\beta_1 c$)
A_s = area of non prestressed tension reinforcement
d_s = distance from extreme compression fiber to the centroid of nonprestressed tensile reinforcement
A'_s = area of compression reinforcement
d' = distance from extreme compression fiber to the centroid of nonprestressed compression reinforcement

Factored flexural resistance:

$$M_r = \phi M_n \qquad \text{(LRFD Eq. 5.7.3.2.1-1)}$$

Where ϕ = resistance factor = 1.00

1. Maximum Limit

The maximum amount of prestressed and nonprestressed reinforcement should be such that:

$$\frac{c}{d_e} \le 0.42 \qquad \text{(LRFD Eq. 5.7.3.3.1-1)}$$

where $d_e = \dfrac{A_{ps} f_{ps} d_p + A_s f_y d_s}{A_{ps} f_{ps} + A_s f_y}$ (LRFD Eq. 5.7.3.3.1-2)

The commentary to the *LRFD Specifications* allows use of the same flexural strength equations as in the *Standard Specifications*, STD Eqs. 9-22 and 9-23, in cases where the maximum reinforcement limit is exceeded.

2. Minimum Limit

At any section, the amount of prestressed and nonprestressed reinforcement should be adequate to developed a factored flexural resistance, M_r, at least equal to the lesser of 1.2 times the cracking strength determined on the basis of elastic stress distribution, or 1.33 times the factored moment required by the applicable strength load combinations.

The *LRFD Specifications* give a similar procedure for computing the cracking moment, M_{cr}.

$$M_{cr} = S_c\left(f_r + f_{pce}\right) - M_{dnc}\left(\frac{S_c}{S_{nc}} - 1\right) \le S_c f_r$$

where S_c, S_{nc} = composite and noncomposite section modulus, f_{cpe} = compressive stress in concrete due to effective prestress forces at extreme fiber of section; f_r = modulus of rupture = $0.24\sqrt{f'_c}$

Contrary to the *Standard Specifications*, the *LRFD Specifications* require that this criterion be met at all sections.

B2.4 TABLE 3.2.6.12 SUMMARY OF WEB SHEAR REINFORCEMENT

- LRFD 5.8.2.4 Regions required transverse reinforcement:

$V_u > 0.5\Phi (V_c + V_p)$ (LRFD Eq. 5.8.2.4-1)

- LRFD 5.8.2.5 Minimum transverse reinforcement:

$$A_v \ge 0.0316\sqrt{f'_c}\,\frac{b_v s}{f_y}$$ (LRFD Eq. 5.8.2.5-1)

- LRFD 5.8.2.7 Maximum spacing of transverse reinforcement:

If $v_u < 0.125f'_c$, *then* $s_{max} = 0.8d_v \le 24$ *inch* (LRFD Eq. 5.8.2.7-1)

If $v_u \ge 0.125f'_c$, *then* $s_{max} = 0.4d_v \le 24$ *inch* (LRFD Eq. 5.8.2.7-2)

- LRFD 5.8.2.9 Shear Stress on Concrete:

$$v_u = \frac{V_u - \varphi V_p}{\phi b_v d_v}$$ (LRFD Eq. 5.8.2.9-1)

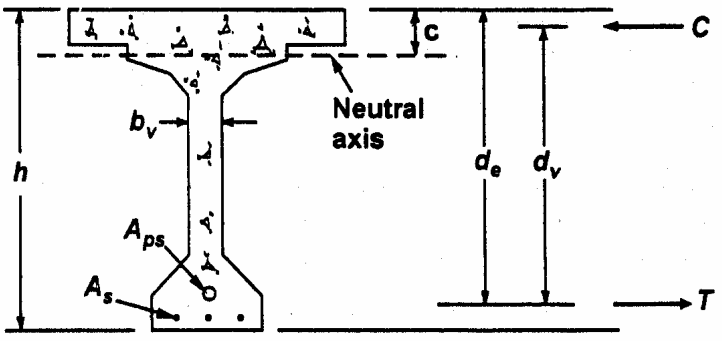


Figure C5.8.2.9-1 - Illustration of the Terms b_v and d_v.

The *LRFD Specifications*, Article 5.8.3 introduces the sectional design model. Subsections 1 and 2 describe the applicable geometry required to use this technique to design web reinforcement.

The nominal resistance is taken the lesser of:

$$V_n = V_c + V_s + V_p \text{, or,} \qquad \text{(LRFD Eq. 5.8.3.3-1)}$$

$$V_n = 0.25 f_c' b_v d_v + V_p \qquad \text{(LRFD Eq. 5.8.3.3-2)}$$

where
b_v = effective web width
d_v = effective shear depth

LRFD Eq. (5.8.3.3-2) represents an upper limit of V_n to assure that the concrete in the web will not crush prior to yield of the transverse reinforcement.

The *LRFD Specifications* defines the concrete contribution as the nominal shear resistance provided by the tensile stresses in the concrete. This resistance is computed using the following equation:

$$V_c = 0.0316 \beta \sqrt{f_c'} b_v d_v \qquad \text{(LRFD Eq. 5.8.3.3-3)}$$

The units used in the *LRFD Specifications* are kips and inches. The factor 0.0316 is equal to

$$\frac{1}{\sqrt{1{,}000}}$$

which coverts the expression from psi to ksi units for the concrete compressive strength.

The contribution of the web reinforcement is given by the general equation:

$$V_s = \frac{A_v f_y d_v (\cot\theta + \cot\alpha)\sin\alpha}{s} \qquad \text{(LRFD Eq. 5.8.3.3-4)}$$

where the angles, 2 and ∀, represent the inclination of the diagonal compressive stresses measured from the horizontal beam axis and the angle of the web reinforcement relative to the horizontal beam axis, respectively.

For cases of vertical web reinforcement, the expression for V_s simplifies to:

$$V_s = \frac{A_v f_y d_v \cot\theta}{s} \qquad \text{(LRFD Eq. C5.8.3.3-1)}$$

Transverse shear reinforcement should be provided when:

$$V_u > 0.5\phi\left(V_c + V_p\right) \qquad \text{(LRFD Eq. 5.8.2.4-1)}$$

When the reaction introduces compression into the end of the member, the critical section of shear is taken as the larger of $0.5d_v\cot\theta$, or d_v, measured from the face of the support.

To determine the nominal resistance, the design engineer must determine ∃ and 2 from the *LRFD Specifications*, Article 5.8.3.4. For mildly reinforced concrete sections, the values of ∃ and 2 are 2 and 45E respectively. These will produce results similar to the *Standard Specifications*. However, for prestressed concrete, the engineer can take advantage of the precompression and use lower angles of 2, which optimizes the web reinforcement.

B2.5 TABLE 3.2.6.12A SUMMARY OF HORIZONTAL SHEAR CHECK

LRFD Specifications give no guidance for computing horizontal shear due to factored loads. The following formula may be used as discussed in Section 3.8.1 with the substitution d_v for *jd*:

$$v_{uh} = \frac{V_u}{d_v b_v} \qquad \text{(PCI Eq. 8.5.3-1)}$$

where
v_{uh} = horizontal factored shear force per unit area of interface
V_u = factored vertical shear force at specified section due to superimposed loads
d_v = the distance between resultants of tensile and compressive forces =
b_v = interface width

Required strength □ nominal strength, or:

$$v_{uh} A_{cv} \le \phi V_n \qquad \text{(PCI Eq. 8.5.3-2)}$$

where V_n = nominal shear resistance of the interface surface
$= cA_{cv} + \mu\left[A_{vf} f_y + P_c\right]$

where
c = cohesion factor = 0.10 for this case
μ = friction factor = 1.0 for this case
A_{cv} = interface area of concrete engaged in shear transfer
A_{vf} = area of shear reinforcement crossing the shear plane within area
P_c = permanent net compressive force normal to the shear plane (may be conservatively neglected)
f_y = yield strength of shear reinforcement

Typically, the top surface of the beam is intentionally roughened to amplitude of 1/4 in.

Therefore, for normal weight concrete cast against hardened, roughened, normal weight concrete, the above relationships may be reduced to the following formula:

$$v_{uh} \le \phi \left(0.1 + A_{vf} f_y / A_{cv}\right) \qquad \text{(PCI Eq. 8.5.3-3)}$$

where the minimum $A_{vf} = \left(0.05 b_v s\right) / f_y$ (LRFD Eq. 5.8.4.1-4)

Nominal shear resistance is the lesser of:

$$V_n \le 0.2 f_c' A_{cv}, \text{ and,} \qquad \text{(LRFD Eq. 5.8.4.1-2)}$$

$$V_n \le 0.8 A_{cv} \qquad \text{(LRFD Eq. 5.8.4.1-3)}$$

While the *LRFD Specifications* require that minimum reinforcement be provided regardless of the stress level at the interface, designers may choose to limit this reinforcement to cases where v_{uh} / ϕ is greater than 0.10 ksi. This would be consistent with the *Standard Specifications*, the ACI Code and other references. It would seem to be impractical and an unnecessary expense to provide connectors in a number of common applications, such as precast stay-in-place panels if the interface stress is lower than 0.10 ksi.

Appendix B3

LRFD THEORY FOR STEEL BRIDGES

1. TABLE 1.2.22.5 =DEPTH/THICKNESS RATIOS (N = n)

6.10.2.1.1 Webs Without Longitudinal Stiffeners

Webs shall be proportioned such that:

$$\frac{D}{t_w} \le 150 \qquad (6.10.2.1.1\text{-}1)$$

6.10.2.1.2 Webs With Longitudinal Stiffeners

Webs shall be proportioned such that:

$$\frac{D}{t_w} \le 300 \qquad (6.10.2.1.2\text{-}1)$$

- the web satisfies the noncompact slenderness limit:

$$\frac{2D_c}{t_w} < 5.7\sqrt{\frac{E}{F_{yc}}} \qquad (6.10.6.2.3\text{-}1)$$

2. TABLE 1.2.22.5A=DEPTH/THICKNESS RATIOS (N = inf.)

- the web satisfies the noncompact slenderness limit:

$$\frac{2D_c}{t_w} < 5.7\sqrt{\frac{E}{F_{yc}}} \qquad (6.10.6.2.3\text{-}1)$$

where:

D_c = depth of the web in compression in the elastic range (in.). For composite sections, D_c shall be determined as specified in Article D6.3.1.

I_{yc} = moment of inertia of the compression flange of the steel section about the vertical axis in the plane of the web (in.^{4})

I_{yt} = moment of inertia of the tension flange of the steel section about the vertical axis in the plane of the web (in.^{4})

3. TABLE 1.2.22.7A=FLB AND LTB CATEGORIES
TABLE 1.2.22.7B=FLB AND LTB RESISTANCE

6.10.8.2.2 Local Buckling Resistance

The local buckling resistance of the compression flange shall be taken as:

- If $\lambda_f \le \lambda_{pf}$, then:

$$F_{nc} = R_b R_h F_{yc} \qquad (6.10.8.2.2\text{-}1)$$

- Otherwise:

$$F_{nc} = \left[1 - \left(1 - \frac{F_{yr}}{R_h F_{yc}}\right)\left(\frac{\lambda_f - \lambda_{pf}}{\lambda_{rf} - \lambda_{pf}}\right)\right] R_b R_h F_{yc} \qquad (6.10.8.2.2\text{-}2)$$

in which:

λ_f = slenderness ratio for the compression flange

$$= \frac{b_{fc}}{2t_{fc}} \qquad (6.10.8.2.2\text{-}3)$$

λ_{pf} = limiting slenderness ratio for a compact flange

$$= 0.38\sqrt{\frac{E}{F_{yc}}} \qquad (6.10.8.2.2\text{-}4)$$

λ_{rf} = limiting slenderness ratio for a noncompact flange

$$= 0.56\sqrt{\frac{E}{F_{yr}}} \qquad (6.10.8.2.2\text{-}5)$$

where:

F_{yr} = compression-flange stress at the onset of nominal yielding within the cross-section, including residual stress effects, but not including compression-flange lateral bending, taken as the smaller of $0.7F_{yc}$ and F_{yw}, but not less than $0.5F_{yc}$

R_b = web load-shedding factor determined as specified in Article 6.10.1.10.2

R_h = hybrid factor determined as specified in Article 6.10.1.10.1

L_p = limiting unbraced length to achieve the nominal flexural resistance of $R_b R_h F_{yc}$ under uniform bending (in.)

$$= 1.0\, r_t \sqrt{\frac{E}{F_{yc}}} \qquad (6.10.8.2.3\text{-}4)$$

L_r = limiting unbraced length to achieve the onset of nominal yielding in either flange under uniform bending with consideration of compression-flange residual stress effects (in.)

$$= \pi\, r_t \sqrt{\frac{E}{F_{yr}}} \qquad (6.10.8.2.3\text{-}5)$$

L_b = unbraced length (in.)

4. TABLE 1.2.22.9=SUMMARY OF STRENGTH CATEGORY OF CROSS SECTION

5. TABLE 1.2.22.10=CONSTRUCTABILITY CHECK

(Eq. 6.10.6.2.3-1 is on the last page of this file.)

$$f_{bu} + f_\ell \le \phi_f R_h F_{yc}, \qquad (6.10.3.2.1\text{-}1)$$

$$f_{bu} + \frac{1}{3} f_\ell \le \phi_f F_{nc}, \qquad (6.10.3.2.1\text{-}2)$$

and

$$f_{bu} \le \phi_f F_{crw} \qquad (6.10.3.2.1\text{-}3)$$

where:

ϕ_f = resistance factor for flexure specified in Article 6.5.4.2.

f_{bu} = flange stress calculated without consideration of flange lateral bending determined as specified in Article 6.10.1.6 (ksi)

f_ℓ = flange lateral bending stress determined as specified in Article 6.10.1.6 (ksi)

F_{crw} = nominal bend-buckling resistance for webs specified in Article 6.10.1.9 (ksi)

F_{nc} = nominal flexural resistance of the flange (ksi). F_{nc} shall be determined as specified in Article 6.10.8.2. For sections in straight I-girder bridges with compact or noncompact webs, the lateral torsional buckling resistance may be taken as M_{nc} determined as specified in Article A6.3.3 divided by S_{xc}. In computing F_{nc} for constructability, the web load-shedding factor, R_b, shall be taken as 1.0.

M_{yc} = yield moment with respect to the compression flange determined as specified in Article D6.2 (kip-in.)

R_h = hybrid factor specified in Article 6.10.1.10.1

S_{xc} = elastic section modulus about the major axis of the section to the compression flange taken as M_{yc}/F_{yc} (in.^{3})

For critical stages of construction, the following requirement shall be satisfied:

$$f_{bu} + f_\ell \le \phi_f R_h F_{yt} \qquad (6.10.3.2.2\text{-}1)$$

6. TABLE 1.2.22.14=STRENGTH LIMIT STATE CHECK

At the strength limit state, the section shall satisfy:

$$M_u + \frac{1}{3} f_\ell S_{xt} \le \phi_f M_n \qquad (6.10.7.1.1\text{-}1)$$

where:

ϕ_f = resistance factor for flexure specified in Article 6.5.4.2

f_ℓ = flange lateral bending stress determined as specified in Article 6.10.1.6 (ksi)

M_n = nominal flexural resistance of the section determined as specified in Article 6.10.7.1.2 (kip-in.)

M_u = bending moment about the major-axis of the cross-section determined as specified in Article 6.10.1.6 (kip-in.)

M_{yt} = yield moment with respect to the tension flange determined as specified in Article D6.2 (kip-in.)

S_{xt} = elastic section modulus about the major axis of the section to the tension flange taken as M_{yt}/F_{yt} (in.^{3})

At the strength limit state, the compression flange shall satisfy:

$$f_{bu} \le \phi_f F_{nc} \qquad (6.10.7.2.1\text{-}1)$$

where:

ϕ_f = resistance factor for flexure specified in Article 6.5.4.2

f_{bu} = flange stress calculated without consideration of flange lateral bending determined as specified in Article 6.10.1.6 (ksi)

F_{nc} = nominal flexural resistance of the compression flange determined as specified in Article 6.10.7.2.2 (ksi)

The tension flange shall satisfy:

$$f_{bu} + \frac{1}{3} f_\ell \le \phi_f F_{nt} \qquad (6.10.7.2.1\text{-}2)$$

where:

f_ℓ = flange lateral bending stress determined as specified in Article 6.10.1.6 (ksi)

F_{nt} = nominal flexural resistance of the tension flange determined as specified in Article 6.10.7.2.2 (ksi)

For shored construction, the maximum longitudinal compressive stress in the concrete deck at the strength limit state, determined as specified in Article 6.10.1.1.1d, shall not exceed $0.6f'_c$.

Lateral bending stresses in continuously braced flanges shall be taken equal to zero. Lateral bending stresses in discretely braced flanges shall be determined by structural analysis. All discretely braced flanges shall satisfy:

$$f_f \le 0.6F_{yf} \qquad (6.10.1.6\text{-}1)$$

At the strength limit state, the following requirement shall be satisfied:

$$f_{bu} + \frac{1}{3} f_\ell \le \phi_f F_{nc} \qquad (6.10.8.1.1\text{-}1)$$

where:

ϕ_f = resistance factor for flexure specified in Article 6.5.4.2

f_{bu} = flange stress calculated without consideration of flange lateral bending determined as specified in Article 6.10.1.6 (ksi)

f_ℓ = flange lateral bending stress determined as specified in Article 6.10.1.6 (ksi)

F_{nc} = nominal flexural resistance of the flange determined as specified in Article 6.10.8.2 (ksi)

At the strength limit state, the following requirement shall be satisfied:

$$f_{bu} + \frac{1}{3} f_\ell \le \phi_f F_{nt} \qquad (6.10.8.1.2\text{-}1)$$

where:

F_{nt} = nominal flexural resistance of the flange determined as specified in Article 6.10.8.3 (ksi)

7. TABLE 1.2.22.15=UNSTIFFENED SECTION SHEAR CAPACITY

- If $\frac{D}{t_w} > 1.40\sqrt{\frac{Ek}{F_{yw}}}$, then:

$$C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2}\left(\frac{Ek}{F_{yw}}\right) \qquad (6.10.9.3.2\text{-}6)$$

in which:

k = shear-buckling coefficient

$$= 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2} \qquad (6.10.9.3.2\text{-}7)$$

8. TABLE 1.2.22.16=SUMMARY OF WEB STRENGTH CATEGORY

6.10.2.1.1 Webs Without Longitudinal Stiffeners

Webs shall be proportioned such that:

$$\frac{D}{t_w} \le 150 \qquad (6.10.2.1.1\text{-}1)$$

6.10.2.1.2 Webs With Longitudinal Stiffeners

Webs shall be proportioned such that:

$$\frac{D}{t_w} \le 300 \qquad (6.10.2.1.2\text{-}1)$$

- the section satisfies the web slenderness limit:

$$\frac{2D_{cp}}{t_w} \le 3.76\sqrt{\frac{E}{F_{yc}}} \qquad (6.10.6.2.2\text{-}1)$$

where:

D_{cp} = depth of the web in compression at the plastic moment determined as specified in Article D6.3.2 (in.)

- the web satisfies the noncompact slenderness limit:

$$\frac{2D_c}{t_w} < 5.7\sqrt{\frac{E}{F_{yc}}} \qquad (6.10.6.2.3\text{-}1)$$

6.10.9.2 Nominal Resistance of Unstiffened Webs

The nominal shear resistance of unstiffened webs shall be taken as:

$$V_n = V_{cr} = CV_p \qquad (6.10.9.2\text{-}1)$$

in which:

$$V_p = 0.58F_{yw}Dt_w \qquad (6.10.9.2\text{-}2)$$

where:

C = ratio of the shear-buckling resistance to the shear yield strength determined by Eqs. 6.10.9.3.2-4, 6.10.9.3.2-5 or 6.10.9.3.2-6 as applicable, with the shear-buckling coefficient, k, taken equal to 5.0

V_{cr} = shear-buckling resistance (kip)

V_n = nominal shear resistance (kip)

V_p = plastic shear force (kip)

Otherwise, the nominal shear resistance shall be taken as follows:

$$V_n = V_p \left[C + \frac{0.87(1-C)}{\left(\sqrt{1+\left(\frac{d_o}{D}\right)^2} + \frac{d_o}{D} \right)} \right] \quad (6.10.9.3.2\text{-}8)$$

in which:

$$V_p = 0.58 F_{yw} D t_w \quad (6.10.9.3.3\text{-}2)$$

where:

C = ratio of the shear-buckling resistance to the shear yield strength determined by Eqs. 6.10.9.3.2-4, 6.10.9.3.2-5, or 6.10.9.3.2-6 as applicable

V_{cr} = shear-buckling resistance (kip)

V_p = plastic shear force (kip)

The transverse stiffener spacing for end panels with or without longitudinal stiffeners shall not exceed 1.5*D*.

9. TABLE 1.2.22.17=TRANSVERSE STIFFENER SPACING

10. TABLE 1.2.22.21=SERVICE LIMIT STATE CHECK

Flanges shall satisfy the following requirements:

- For the top steel flange of composite sections:

$$f_f \le 0.95 R_h F_{yf} \quad (6.10.4.2.2\text{-}1)$$

- For the bottom steel flange of composite sections:

$$f_f + \frac{f_\ell}{2} \le 0.95 R_h F_{yf} \quad (6.10.4.2.2\text{-}2)$$

- For both steel flanges of noncomposite sections:

$$f_f + \frac{f_\ell}{2} \le 0.80 R_h F_{yf} \quad (6.10.4.2.2\text{-}3)$$

The nominal bend-buckling resistance shall be taken as:

$$F_{crw} = \frac{0.9Ek}{\left(\frac{D}{t_w}\right)^2} \quad (6.10.1.9.1\text{-}1)$$

but not to exceed the smaller of $R_h F_{yc}$ and $F_{yw}/0.7$.

in which:

k = bend-buckling coefficient

$$= \frac{9}{\left(D_c / D\right)^2} \qquad (6.10.1.9.1\text{-}2)$$

where:

D_c = depth of the web in compression in the elastic range (in.). For composite sections, D_c shall be determined as specified in Article D6.3.1.

R_h = hybrid factor specified in Article 6.10.1.10.1

When both edges of the web are in compression, k shall be taken as 7.2.

V_{sr} = horizontal fatigue shear range per unit length (kip/in.)

$$= \sqrt{\left(V_{fat}\right)^2 + \left(F_{fat}\right)^2} \qquad (6.10.10.1.2\text{-}2)$$

V_{fat} = longitudinal fatigue shear range per unit length (kip/in.)

11. TABLE 1.2.22.23A=FATIGUE STRESS RANGE FOR TRUCK

12. TABLE 1.2.22.24=SHEAR CONNECTOR (FATIGUE CRITERIA)

The fatigue shear resistance of an individual stud shear connector, Z_r, shall be taken as:

$$Z_r = \alpha d^2 \geq \frac{5.5 d^2}{2} \qquad (6.10.10.2\text{-}1)$$

in which:

$$\alpha = 34.5 - 4.28 \log N \qquad (6.10.10.2\text{-}2)$$

where:

d = diameter of the stud (in.)

N = number of cycles specified in Article 6.6.1.2.5

13. TABLE 1.2.22.24A=SHEAR CONNECTOR (STRENGTH LIMIT STATE)

6.10.10.4 Strength Limit State

6.10.10.4.1 General

The factored shear resistance of a single shear connector, Q_r, at the strength limit state shall be taken as:

$$Q_r = \phi_{sc} Q_n \qquad (6.10.10.4.1\text{-}1)$$

where:

Q_n = nominal shear resistance of a single shear connector determined as specified in Article 6.10.10.4.3 (kip)

ϕ_{sc} = resistance factor for shear connectors specified in Article 6.5.4.2

At the strength limit state, the minimum number of shear connectors, *n*, over the region under consideration shall be taken as:

$$n = \frac{P}{Q_r} \qquad (6.10.10.4.1\text{-}2)$$

where:

P = total nominal shear force determined as specified in Article 6.10.10.4.2 (kip)

Q_r = factored shear resistance of one shear connector determined from Eq. 1 (kip)

P_p = total longitudinal shear force in the concrete deck at the point of maximum positive live load plus impact moment (kip) taken as the lesser of either:

$$P_{1p} = 0.85\, f'_c b_s t_s \qquad (6.10.10.4.2\text{-}2)$$

or

$$P_{2p} = F_{yw} D t_w + F_{yt} b_{ft} t_{ft} + F_{yc} b_{fc} t_{fc} \quad (6.10.10.4.2\text{-}3)$$

F_p = total radial shear force in the concrete deck at the point of maximum positive live load plus impact moment (kip) taken as:

$$F_p = P_p \frac{L_p}{R} \qquad (6.10.10.4.2\text{-}4)$$

where:

b_s = effective width of the concrete deck (in.)

t_s = thickness of the concrete deck (in.)

L_p = arc length between an end of the girder and an adjacent point of maximum positive live load plus impact moment (ft.)

R = minimum girder radius over the length, L_p (ft.)

$$P_T = P_p + P_n \qquad (6.10.10.4.2\text{-}6)$$

P_n = total longitudinal shear force in the concrete deck over an interior support (kip) taken as the lesser of either:

$$P_{1n} = F_{yw} D t_w + F_{yt} b_{ft} t_{ft} + F_{yc} b_{fc} t_{fc} \quad (6.10.10.4.2\text{-}7)$$

or

$P_{2n} = 0.45 f'_c b_s t_s$ (6.10.10.4.2-8

14. TABLE 1.2.22.24B=RECOMMANDED SHEAR CONNECTOR REQUIRED PITCH
TABLE 1.2.22.24C=TENSION-COMPRESSION-REVERSAL AREAS

APPENDIX C

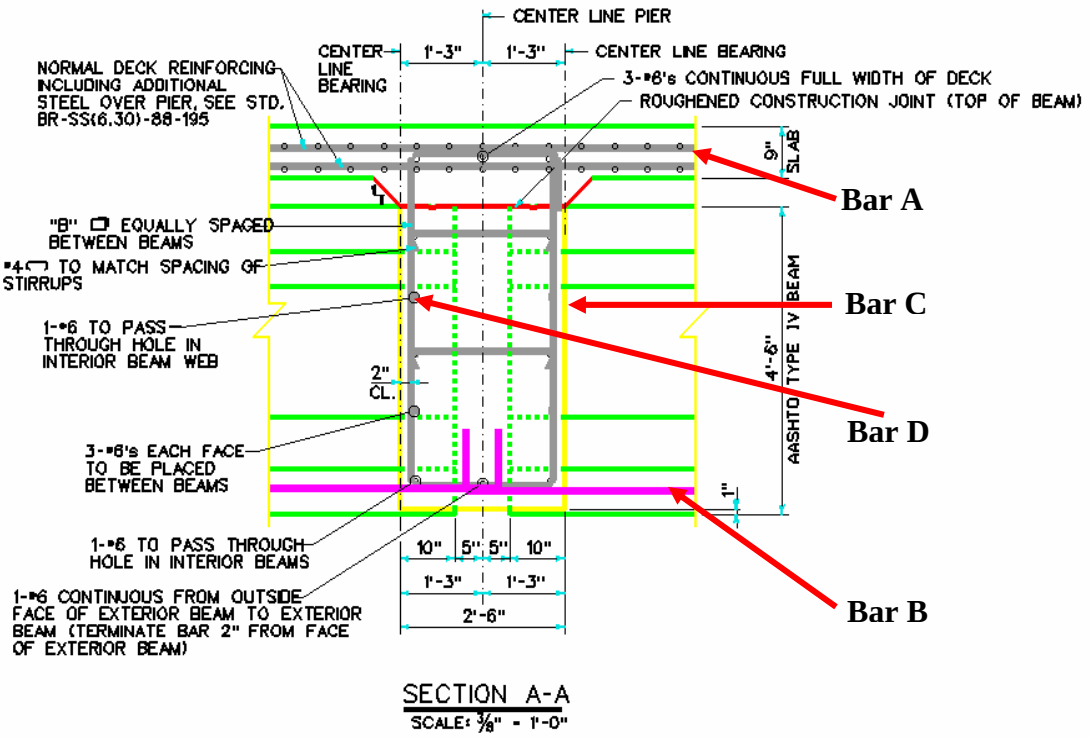
Pier Continuity PC Girder LRFD Design

C1. Purpose of the program

Design and analysis based on AASHTO/LRFD of PC bridges composed of simple span precast girders made continuous for live loads. If the minimum age of the precast girder is at least 90 days, based on AASHTO/LRFD the positive moment connection is designed as $1.2M_{cr}$. If the age of girders is within 90 days, time-dependent restraint moments at interior supports of a continuous bridge are calculated. The calculation based on NCHRP 519 depends on girder age at the time continuity is established, properties of the girder and slab concrete, and bridge and girder geometry.

C2. Design and adequacy check

(a) To obtain and check the negative moment reinforcement (Bar A)
(b) To check the negative moment at the pier
(c) To obtain and check the positive moment connection (Bar B)
(d) To obtain and check the diaphragm reinforcement between girders (Bars C & D)



C3. Calculated

(a) Bar (A): Based on the reinforcement provided by the selected Standard Slab and additional negative moment slab reinforcement at the pier, adequacy is checked.
Bar (A) in Design Results Table is the summation of the two, and the total area and the distance can be used for DASH input.

(b) Negative moment: Calculated ultimate moment is checked against total factored negative moment provided by the user and the 1.2 times the cracking moment

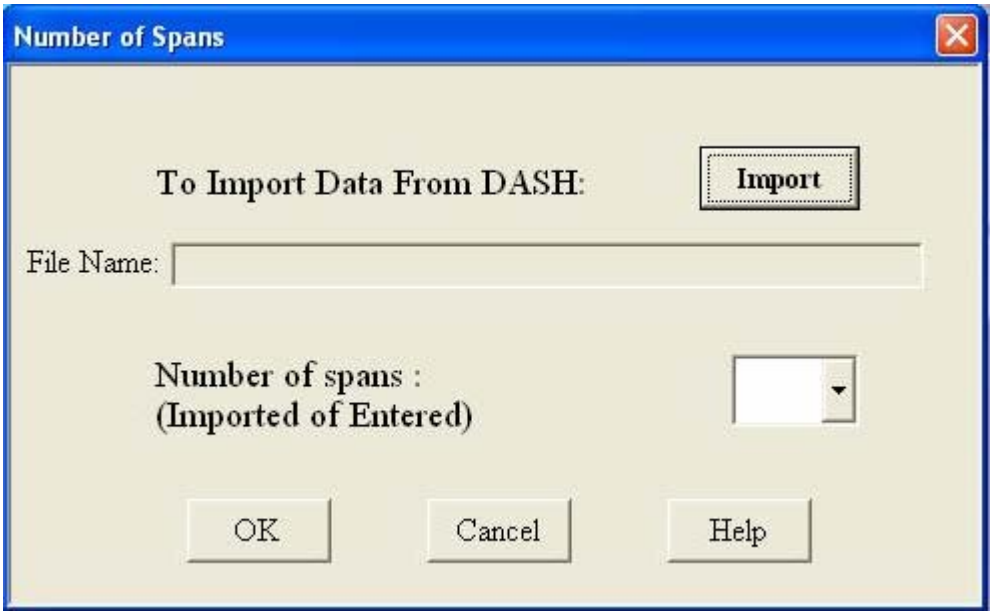
(c) Bar (B): Depending on the girder age at continuity, based on either the restraint moment calculated at the pier or 0.6 times the cracking moment for girders age less than 90 days or 1.2 times the cracking moment for girders age more than 90 days, Bar (B) is designed and checked for two design options, steel bars or strands. Bar (B) can be the reinforcement extended from the precast girders.

(d) Bars (C) and (D): Based on the minimum reinforcement requirement, Bars (C) and (D) are obtained and checked.

C4. Input data

The available input screens are Number of Spans, Input Data for Continuous girder, Concrete & Steel Data, Loads Data & Continuity Details.

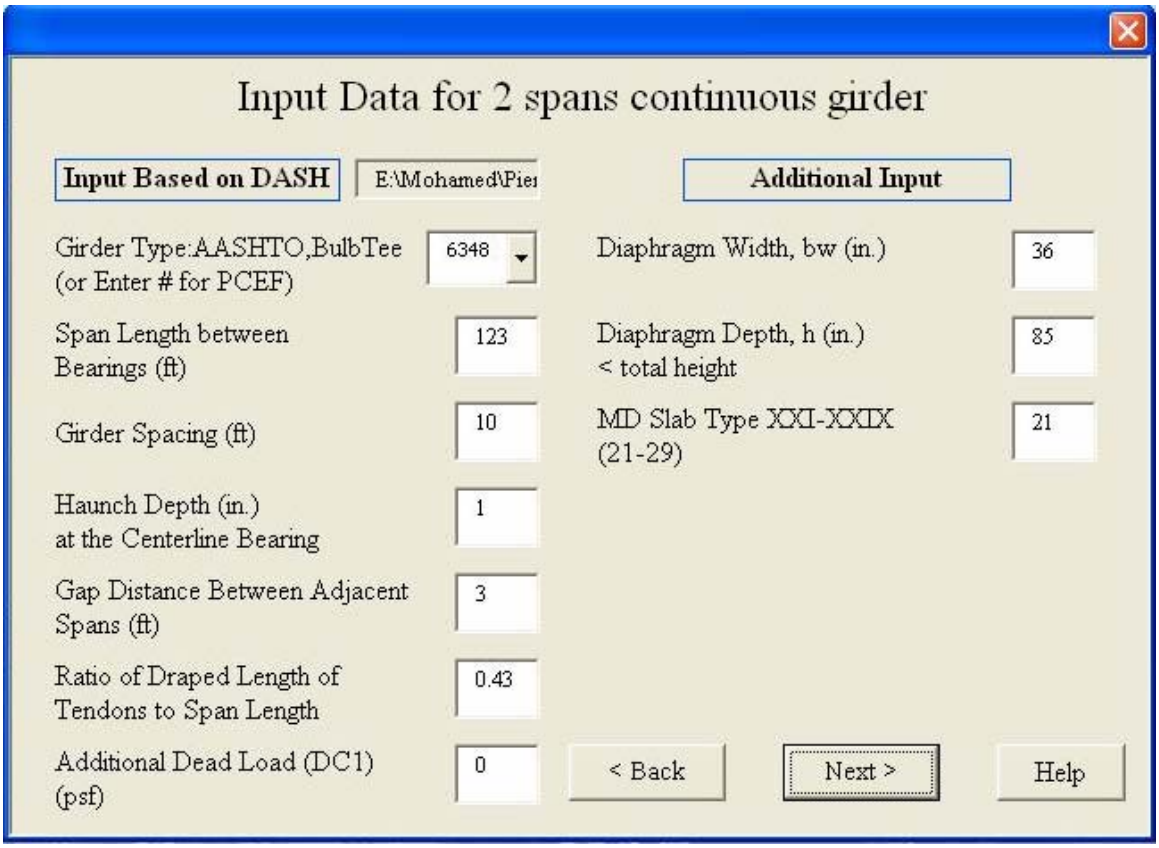
Input Screen 1: Number of Spans



To Import Data from DASH: Use this option to browse and import data from DASH file

Number of spans: Number of spans of continuous girder, either imported from DASH or entered manually (imported or entered).

Input Screen 2: Input Data for Continuous Girder



Input Based on DASH:

Girder Type: AASHTO, BulbTee Imported from DASH for AASHTO or BulbTee girders, or entered manually for PCEF (or Enter # for PCEF).

Span Length between Bearings (ft): Span length incase of 2 spans girder Exterior span incase of 3 spans girders and more.

Interior Span Length between Bearing (ft): Interior span length incase of 3 or 4 spans girder, First interior span length incase of 5 spans girder.

Second Interior Span Length between Bearing (ft): Second interior span length incase of 5 spans girder.

Girder Spacing (ft): Main girder spacing.

Haunch Depth (in.) at the Centerline Bearing: Haunch depth above the PC girder.

Gap Distance between Adjacent Spans (ft): Gap distance between overhangs at the interior pier.

Ratio of Draped Length of Tendons to Span Length: For draped case. Otherwise, enter zero.

Additional Dead Load (DC1) (psf): Enter zero here. All pier moments will be calculated by DASH and entered to the 4th screen.

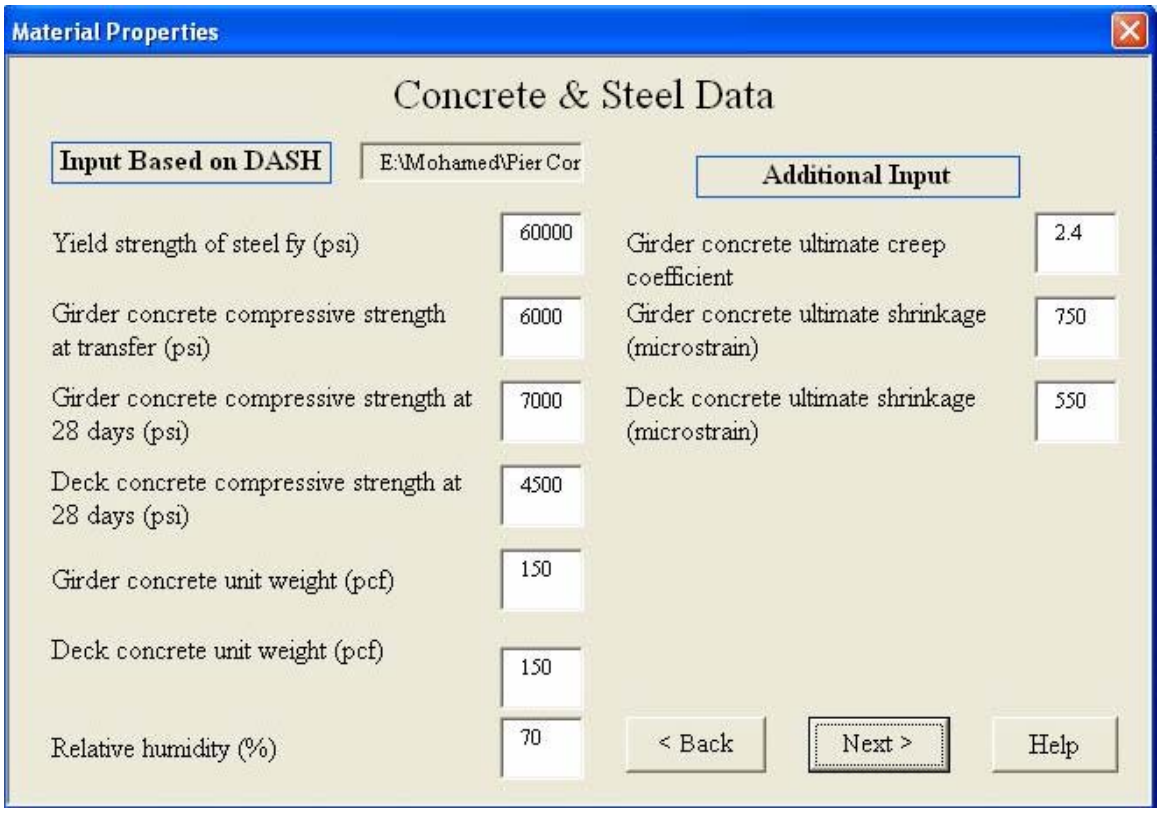
Additional Input:

Diaphragm Width, b_w (in.): Pier diaphragm width.

Diaphragm Depth, h (in.) < total height: Pier diaphragm depth.

MD Slab Type XXI-XXIX (21-29): Maryland slab types as defined on sheet "tables".

Input Screen 3: Concrete & Steel Data



Input Based on DASH:

Yield strength of steel f_y (psi): Reinforcement yield strength.

Girder concrete compressive strength at transfer (psi): Girder concrete compressive strength at transfer.

Girder concrete compressive strength at 28 days (psi): Girder concrete compressive strength at 28 days.

Deck concrete compressive strength at 28 days (psi): Deck concrete compressive strength at 28 days.

Girder concrete unit weight (pcf): Girder concrete unit weight.

Deck concrete unit weight (pcf): Deck concrete unit weight.

Relative humidity (%): Relative humidity in percent

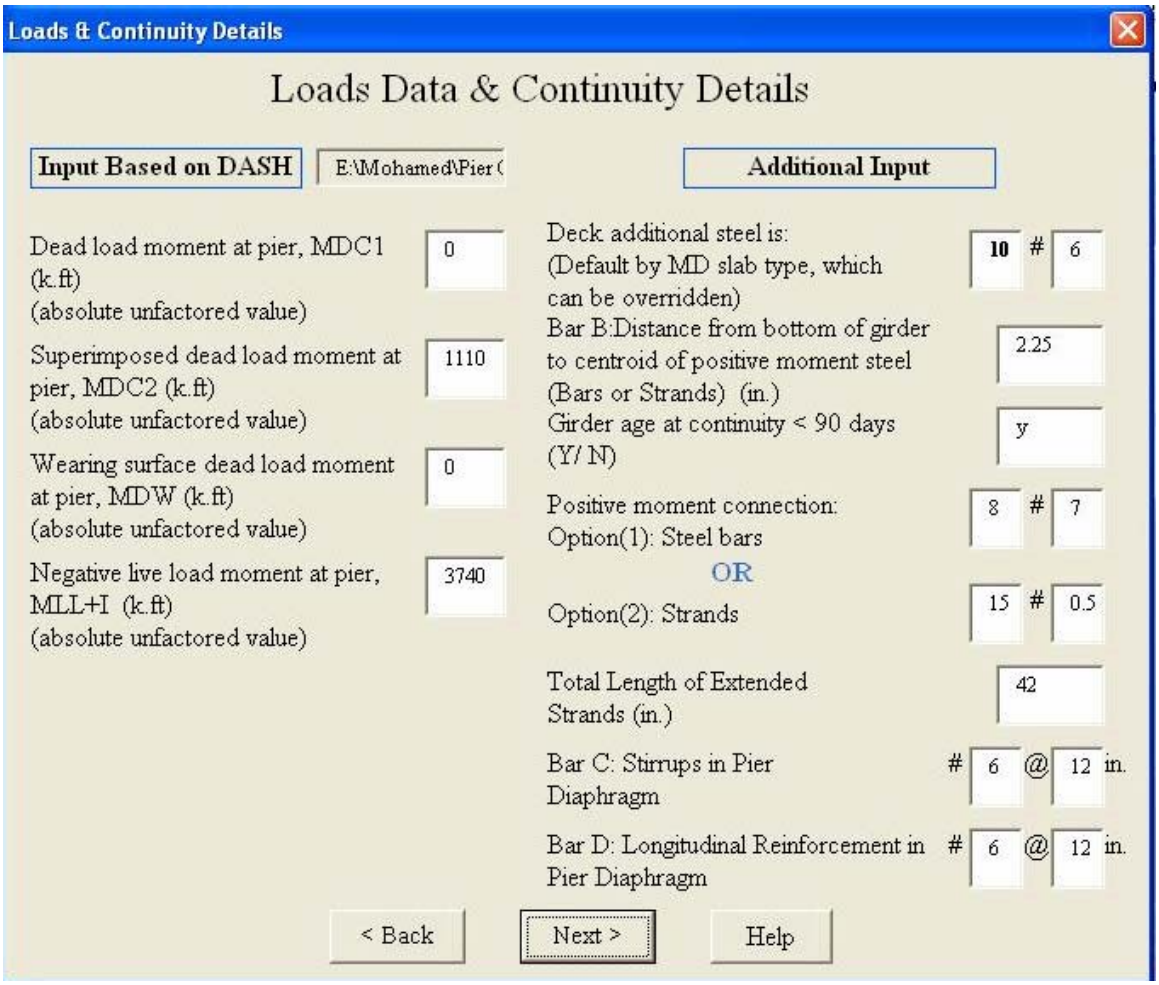
Additional Input:

Girder concrete ultimate creep coefficient: Girder concrete ultimate creep coefficient.

Girder concrete ultimate shrinkage (microstrain): Girder concrete ultimate shrinkage (microstrain).

Deck concrete ultimate shrinkage (microstrain): Deck concrete ultimate shrinkage (microstrain).

Input Screen 4: Load Data & Continuity Details


Loads & Continuity Details
Loads Data & Continuity Details
Input Based on DASH
E:\Mohamed\Pier (
Additional Input
Dead load moment at pier, MDC1 (k.ft) (absolute unfactored value)
0
Superimposed dead load moment at pier, MDC2 (k.ft) (absolute unfactored value)
1110
Wearing surface dead load moment at pier, MDW (k.ft) (absolute unfactored value)
0
Negative live load moment at pier, MLL+I (k.ft) (absolute unfactored value)
3740
Deck additional steel is: (Default by MD slab type, which can be overridden)
10 # 6
Bar B:Distance from bottom of girder to centroid of positive moment steel (Bars or Strands) (in.)
2.25
Girder age at continuity < 90 days (Y/ N)
y
Positive moment connection: Option(1): Steel bars
8 # 7
OR
Option(2): Strands
15 # 0.5
Total Length of Extended Strands (in.)
42
Bar C: Stirrups in Pier Diaphragm
6 @ 12 in.
Bar D: Longitudinal Reinforcement in Pier Diaphragm
6 @ 12 in.
< Back
Next >
Help

Input Based on DASH:

Dead load moment at pier, MDC1 (k.ft) (absolute unfactored value): Dead load moment at pier, MDC1 (k.ft) (absolute unfactored value).

Superimposed dead load moment at pier, MDC2 (k.ft) (absolute unfactored value): Superimposed dead load moment at pier, MDC2 (k.ft) (absolute unfactored value).

Wearing surface dead load moment at pier, MDW (k.ft) (absolute unfactored value): Wearing surface dead load moment at pier, MDW (k.ft) (absolute unfactored value).

Negative live load moment at pier, MLL+I (k.ft) (absolute unfactored value): Negative live load moment at pier, MLL+I (k.ft) (absolute unfactored value)

Additional Input:

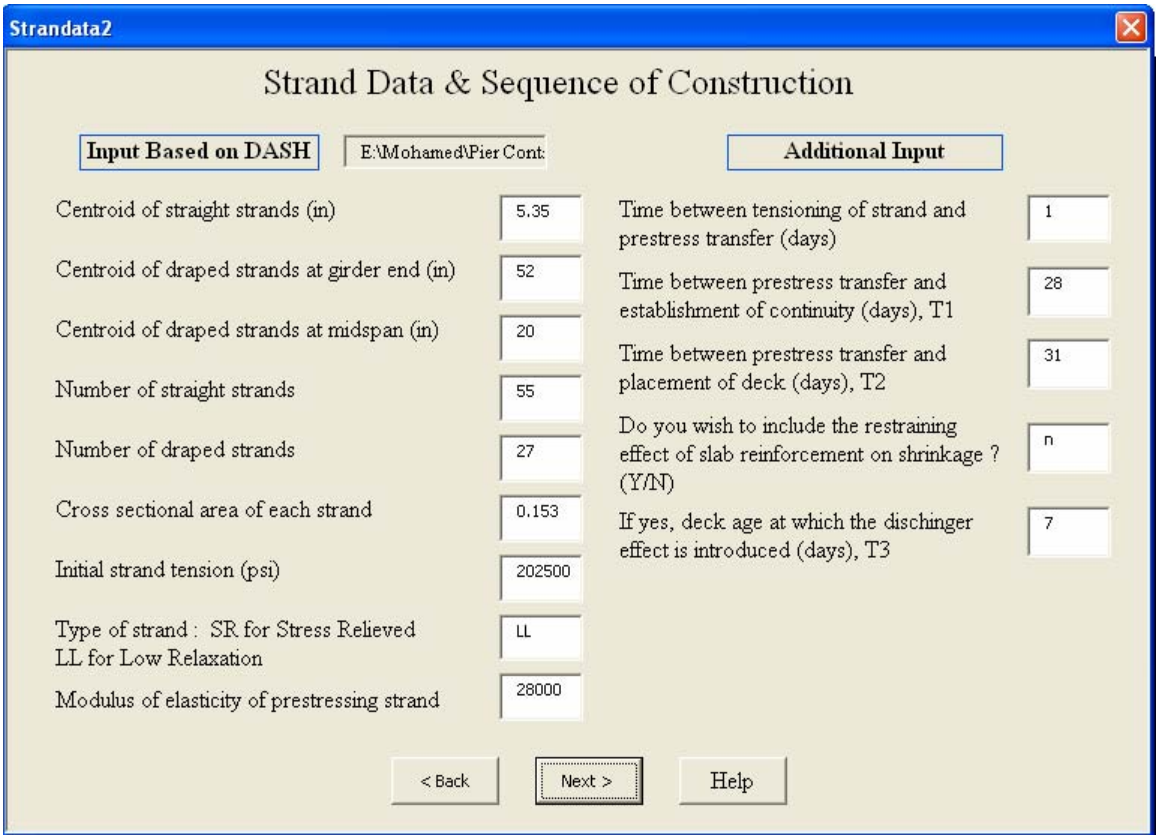
Deck additional steel is: (Default by MD slab type, which can be overridden):

Bar B: Distance from bottom of girder to centroid of positive moment steel (bars or strands) (in.): Bar B, which can be rebars or strands as shown and defined on sheet "Continuity-details".

Girder age at continuity < 90 days (Y/ N): As defined in the 4th Edition of AASHTO-LRFD 5.14.1.4 for restraint moment.

Positive moment connection Option (1): Steel bars: Option (1): Steel bars for the positive moment connection at the pier.
OR
Option (2): Strands: Option (2): Strands for the positive moment connection at the pier.
Total Length of Extended Strands (in.): If option (2) is selected, prove the total Length of Extended Strands. Otherwise, leave blank or zero.
Bar C: Stirrups in Pier Diaphragm: Bar C as shown and defined on sheet "Continuity-details".
Bar D: Longitudinal Reinforcement in Pier Diaphragm: Bar D as shown and defined on sheet "Continuity-details".

Input Screen 5: Load Data & Continuity Details


Strandata2
Strand Data & Sequence of Construction
Input Based on DASH
E:\Mohamed\Pier Cont
Additional Input
Centroid of straight strands (in)
5.35
Centroid of draped strands at girder end (in)
52
Centroid of draped strands at midspan (in)
20
Number of straight strands
55
Number of draped strands
27
Cross sectional area of each strand
0.153
Initial strand tension (psi)
202500
Type of strand : SR for Stress Relieved
LL for Low Relaxation
LL
Modulus of elasticity of prestressing strand
28000
Time between tensioning of strand and prestress transfer (days)
1
Time between prestress transfer and establishment of continuity (days), T1
28
Time between prestress transfer and placement of deck (days), T2
31
Do you wish to include the restraining effect of slab reinforcement on shrinkage ? (Y/N)
n
If yes, deck age at which the dischinger effect is introduced (days), T3
7
< Back
Next >
Help

Input Based on DASH:
Centroid of straight strands (in): Distance from bottom to the centroid of straight strands.
Centroid of draped strands at girder end (in): Distance from bottom to the centroid of draped strands at girder end.
Centroid of draped strands at midspan (in): Distance from bottom to the centroid of draped strands at midspan.
Number of straight strands: Number of straight strands.
Number of draped strands: Number of draped strands.
Cross sectional area of each strand: Cross sectional area of each strand.
Initial strand tension (psi): Initial strand tension (psi).

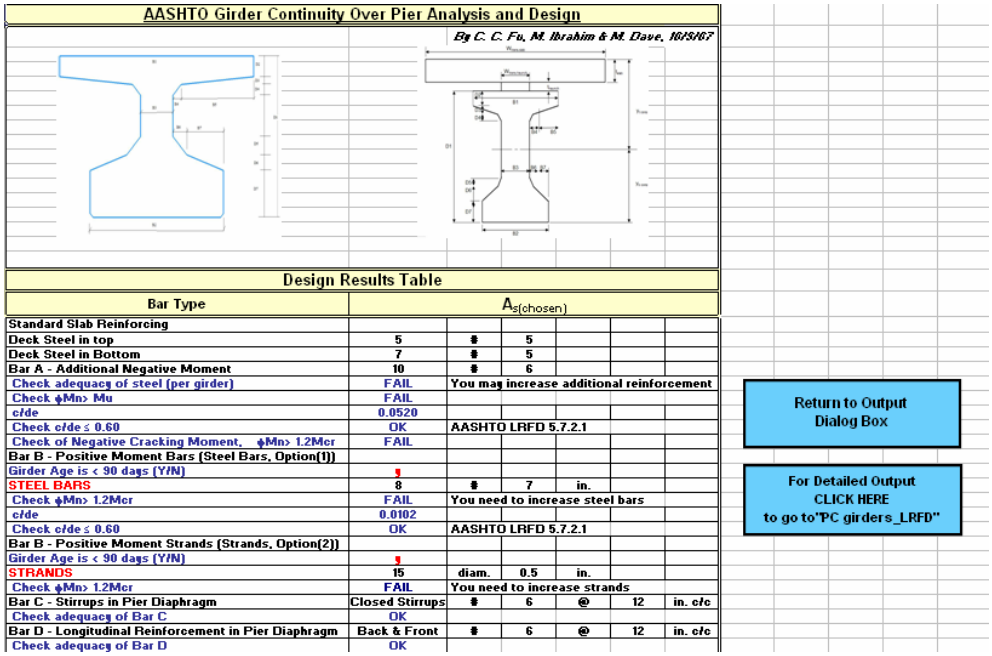
Type of strand: SR for Stress Relieved, LL for Low Relaxation: Type of strand: SR for Stress Relieved, LL for Low Relaxation.
Modulus of elasticity of prestressing strand: Modulus of elasticity of prestressing strand.
Additional Input:
Time between tensioning of strand and prestress transfer (days): Time between tensioning of strand and prestress transfer (days).
Time between prestress transfer and establishment of continuity (days), T1: Time between prestress transfer and establishment of continuity (days), T1.
Time between prestress transfer and placement of deck (days), T2: Time between prestress transfer and placement of deck (days), T2.
Do you wish to include the restraining effect of slab reinforcement on shrinkage? (Y/N): Including Dischinger effect or not.
If yes, deck age at which the dischinger effect is introduced (days), T3: Deck age at which the dischinger effect is introduced (days), T3.

C5. Output Data

There are two options for the output data. Either summarized output for the design results, which can be accessed from the output screen or detailed output print.

Back: go back to input screens to modify data.

Print Results: print summery of analysis results. After clicking on this, you will go to the "print" sheet where you can print a summarized table of the design results and also you can find the other option to print a detailed output table.



AASHTO Girder Continuity Over Pier Analysis and Design

By C. C. Fu, M. Ibrahim & M. Dave, 10/3/07

Design Results Table

Bar Type	$A_{s(chosen)}$					
Standard Slab Reinforcing						
Deck Steel in top	5	#	5			
Deck Steel in Bottom	7	#	5			
Bar A - Additional Negative Moment	10	#	6			
Check adequacy of steel (per girder)	FAIL	You may increase additional reinforcement				
Check ϕMn> Mu	FAIL					
c/de	0.0520					
Check c/de ≤ 0.60	OK	AASHTO LRFD 5.7.2.1				
Check of Negative Cracking Moment, ϕMn> 1.2Mcr	FAIL					
Bar B - Positive Moment Bars (Steel Bars, Option(1))						
Girder Age is < 90 days (Y/N)						
STEEL BARS	8	#	7	in.		
Check ϕMn> 1.2Mcr	FAIL	You need to increase steel bars				
c/de	0.0102					
Check c/de ≤ 0.60	OK	AASHTO LRFD 5.7.2.1				
Bar B - Positive Moment Strands (Strands, Option(2))						
Girder Age is < 90 days (Y/N)						
STRANDS	15	diam.	0.5	in.		
Check ϕMn> 1.2Mcr	FAIL	You need to increase strands				
Bar C - Stirrups in Pier Diaphragm	Closed Stirrups	#	6	@	12	in. c/c
Check adequacy of Bar C	OK					
Bar D - Longitudinal Reinforcement in Pier Diaphragm	Back & Front	#	6	@	12	in. c/c
Check adequacy of Bar D	OK					

Return to Output Dialog Box

For Detailed Output CLICK HERE to go to"PC girders_LRFD"

New Run: go back to 1st input screen to run new analysis.
Exit: exit analysis and goes to MainSheet.